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Meteo and irradiation data during BEST TWO,
Mourmelon

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Meteo and irradiation data during BEST TWO,
Mourmelon

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institute : TNO Physics and Electronics Laboratory

date : April 1991
NDRO no. : A90KL621
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Research supervised by: Ir. A.N. de Jong
Research carried out by: Ir. Y.H.L. Janssen, P.J. Fritz

ABSTRACT (UNCLASSIFIED)

In August 1990 the BEST TWO experiments were held at Camp Mourmelon, organised by NATO AC243 P04 RSG15 group.

During their measuring periods the research group infrared (IR) of FEL TNO (Netherlands) collected several meteo and irradiation data for support and validation of their transmission, visual and infrared contrast experiments.

Meteo data consist of ambient temperature, relative humidity and windspeed. Visual hemispherical radiation on a horizontal surface is measured together with visual radiation on five sides of a cube (top and four vertical sides) and visual irradiation on three boards with elevation angles of 90, 60 and 30 degrees. For support of experiments in the infrared wavelength range, apparent temperatures of a vertical black and white board were measured.

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titel : **Meteo- en stralingsdata tijdens BEST TWO, Mourmelon**

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instituut : **Fysisch en Elektronisch Laboratorium TNO**

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Onderzoek uitgevoerd o.l.v.: **Ir. A.N. de Jong**
Onderzoek uitgevoerd door: **Ir. Y.H.L. Janssen, P.J. Fritz**

SAMENVATTING (ONGERUBRICEERD)

In augustus 1990 zijn in Camp Mourmelon de BEST TWO experimenten gehouden, georganiseerd door de NATO AC243 P04 RSG15 groep. De groep infrarood van het FEL TNO heeft tijdens haar meetsessies meteo- en stralingsdata verzameld, ter ondersteuning en validatie van ondermeer transmissie, visuele en infrarood contrast experimenten.

Als meteodata zijn luchttemperatuur, relatieve vochtigheid en windsnelheid verzameld. De visuele hemisferische zonne- en omgevingsstraling die invalt op een horizontaal vlak is gemeten naast de visuele straling die invalt op vijf zijden van een kubus, de top en de vier verticale zijden. Verder is de hoeveelheid straling bepaald die invalt op vlakken met elevatiehoeken van 30, 60 en 90 graden. Voor ondersteuning van de experimenten in het infrarood zijn de schijnbare temperaturen van een verticale witte en zwarte plaat gemeten.

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1

INTRODUCTION

Measurements performed by the researchgroup infrared (FEL TNO, Netherlands) dealt mainly with the following BEST TWO objectives (BES90):

- determination of the effectiveness of electro optical EO systems under adverse European atmospheric conditions with and without battlefield events
- examination of the effects in the near and far fields of single and multiple emissive sources and transient events
- collecting data on the acquisition of static and moving ground vehicles in natural clutter conditions with and without battlefield events in a European environment at ranges out to 4 km

The experiments performed by the group infrared concerned:

- Multipath Transmission Radiometer measurements (MPTR)
- Minimum Resolvable Temporal Difference measurements (MRTD)
- infrared contrast and target signature experiments (IR-18 camera)
- visual contrast and target signature experiments (CCD-camera)

On these experiments will be reported separately. To be able to validate these experiments properly it was necessary to collect some background data. These background data, presented in this report, can be devided in three main parts:

1. meteo data
2. irradiation data
3. apparent temperature data

Meteo data consist of ambient temperature ($^{\circ}$ C), relative humidity (%) and windspeed (m/s). Irradiation data consist of hemispherical irradiation (W/m^2) incident on a horizontal plate, irradiation incident on plates with elevation angles of 90, 60 and 30 degrees and irradiation incident on five sides of a cube (top and four vertical sides with orientation SE, SW, NW and NE). Apparent temperatures are collected from vertical white and black boards.

The meteo and radiation set up was realised by J.J. van der Ende, A. Offerman and P.J. Fritz. Operation of the sensor was carried out by W. van Bommel. All data were gathered and plotted together with P.J. Fritz. All participants are greatly acknowledged for their contributions.

2

INSTRUMENTATION AND SET UP

2.1 Instrumentation

Meteorological data:

Ambient temperature is measured by a platinum resistance (W. Lambrecht, K.G. Gottingen). Relative humidity is determined by a hydrometer and windspeed is measured by a windspeed sensor (H. Goldbrunner, D. Neckor). These meteorological data are collected by a meteostation (for more detailed information see DRE).

Irradiation data:

To determine the hemispherical radiation on a horizontal surface, radiation was measured by a solarimeter (Kipp & Zonen, CM5). The solarimeter consists of a thermopile covered by a head of bold glass (Scott K5). The 50% intensity spectral range is between 305 and 2800 nm.

To determine the radiation on a surface with certain slope and direction, irradiance is measured with a BPW34 photodiode covered by a Wratten 89B filter. Spectral transmittance of both sensor and filter are shown in figure 2.1.

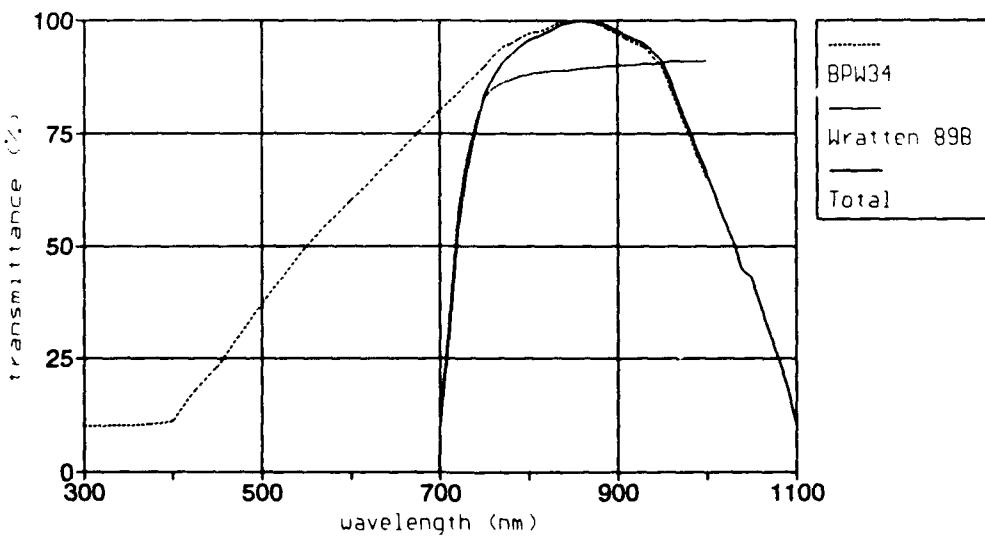


Fig 2.1: Transmittance of BPW34 photodiode, Wratten 89B filter and total transmittance.

Apparent temperature data:

Apparent temperatures are determined by radiometers covered with two filters. The total spectral range is between 2 and 16 μm . Figure 2.2 shows the total relative response of radiometers with filters.

Filter

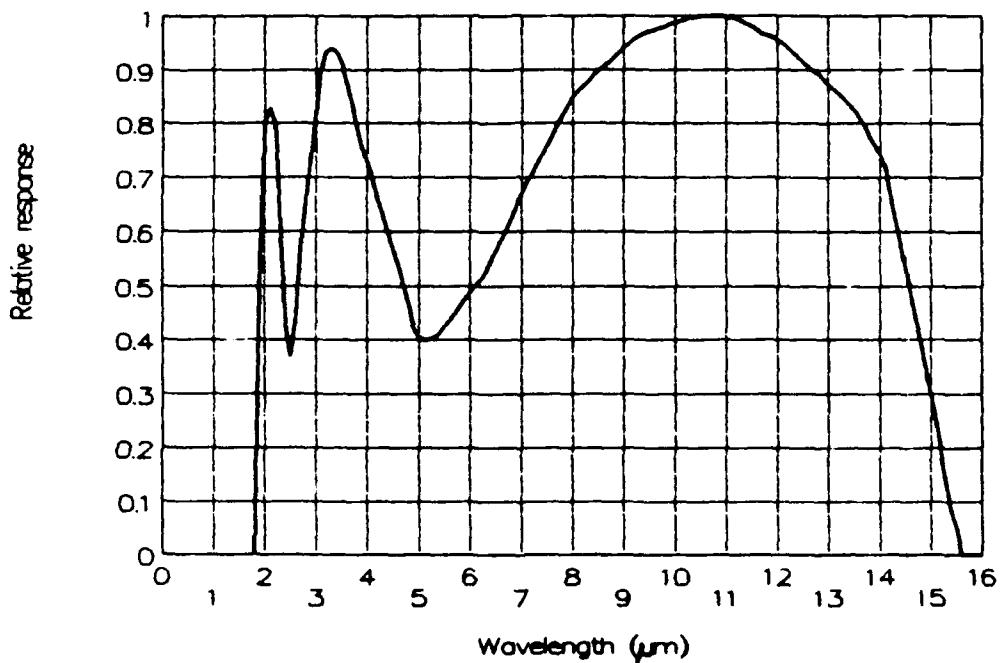


Fig 2.2: Relative response of radiometers with filters.

2.2 Set up

Meteo, irradiation and apparent temperature data were collected at a distance of about 2.5 km from the main instrumentation area. Coordinates and orientation of the instrumentation area are shown in figures 2.3 and 2.4.

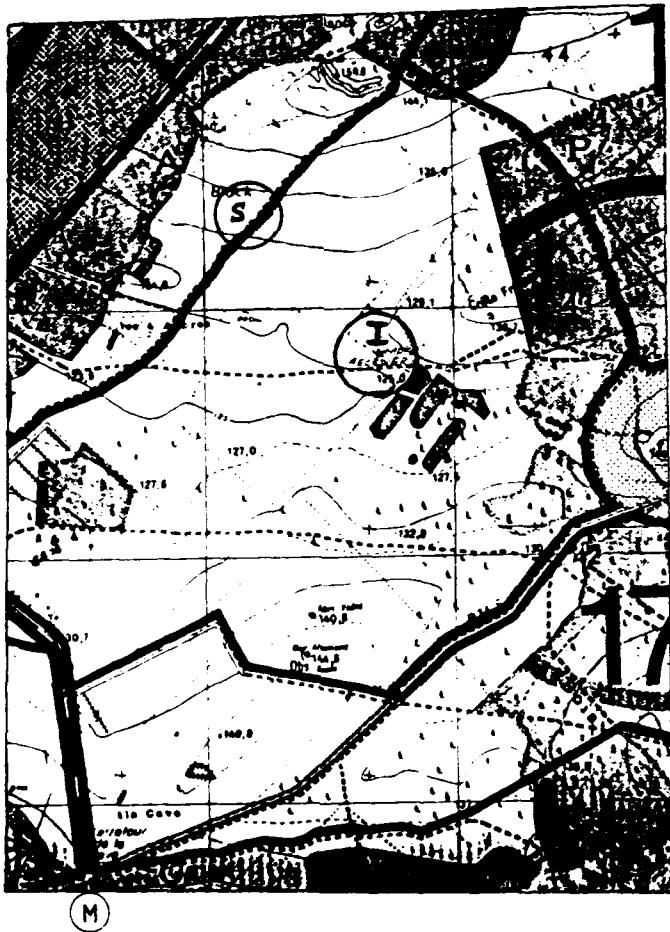


Fig 2.3: Position of set up on camp Mourmelon
with:
I: set up measurements group IR FEL-TNO
M: main instrumentation area
S: set up meteo and radiation data

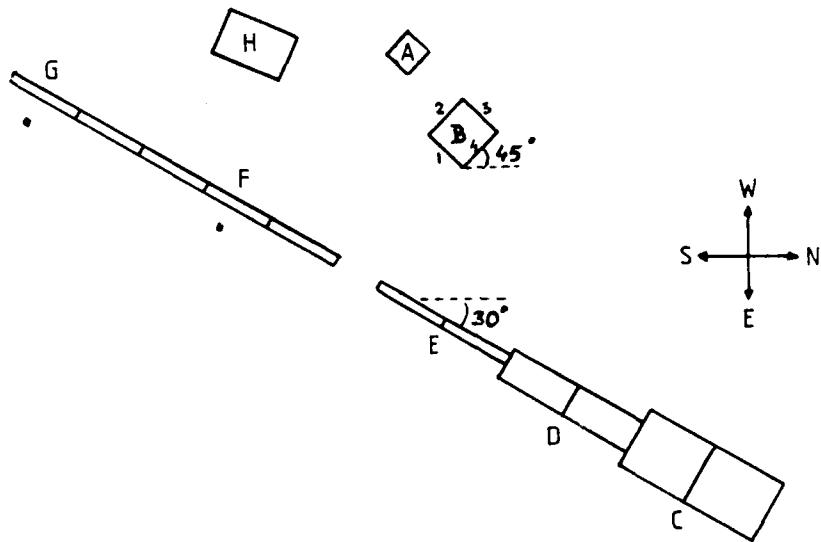


Fig 2.4: Top view and orientation of instrumentation set up
with:
A: meteobox
B: cube for measuring radiation in five perpendicular directions
C,D,E: boards for measuring radiation under elevation angles of
respectively 30, 60 and 90 degrees
F,G: measuring of radiation temperatures of respectively vertical black and
white boards
H: data storage

Meteo data are measured 1.5 m above ground level and at a distance of at least 2 m from the nearest obstacle. The solarimeter is placed at the top of the meteostation. Irradiation in five perpendicular directions is measured with a photodiode and filter on each side of the cube, except the bottom. The box and its orientation (top, SE, SW, NW and NE) are shown in figure 2.4. Position and orientation of the white and black boards (measuring apparent temperatures) and the boards with different elevation angles are shown in figure 2.4 and photos 2.5a and 2.5b.

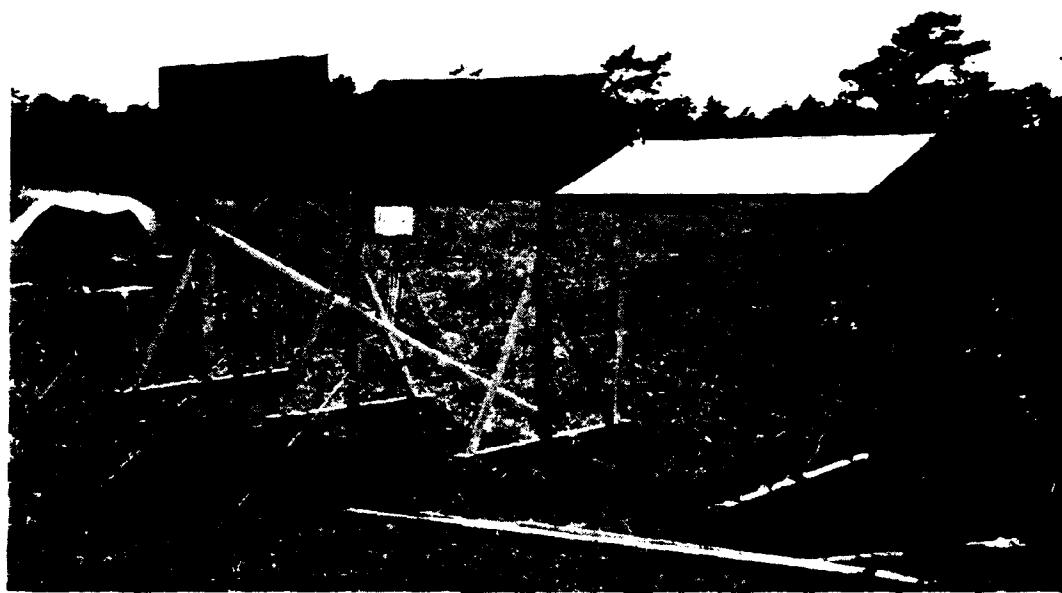


Photo 2.5a: Boards under different slopes for measuring irradiation.

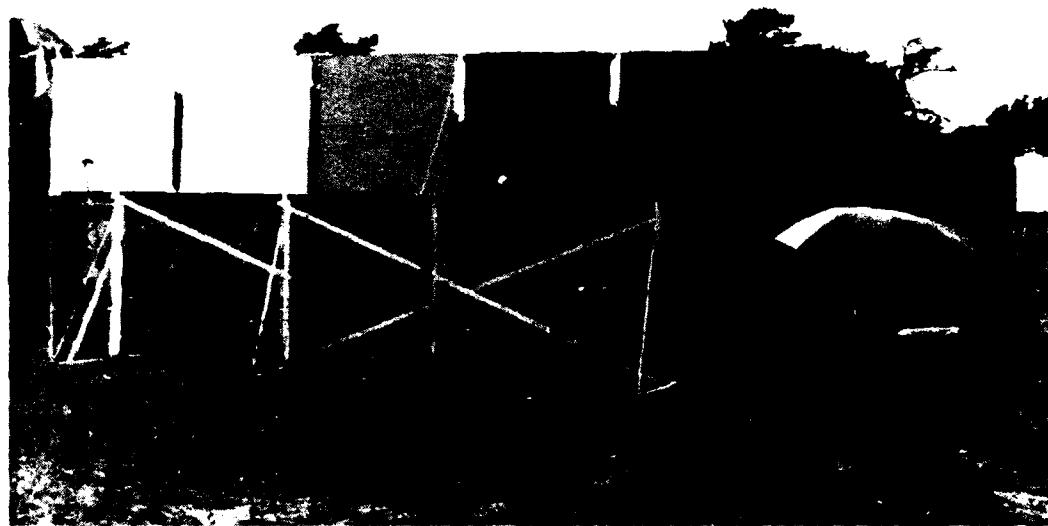


Photo 2.5b: White and black boards for measuring radiation temperatures.

2.3 Data collection

The measuring units are selfregistering. Meteo data are registered every 10 seconds and send to a plotter and a PC. Irradiation and apparent temperature data are digital stored on a PC every 10 seconds and their average values are calculated and stored every 15 minutes.

2.4 Measuring days and times

date (DD-MM-YY)	time (HH:MM)
30-07-1990	09:00 - 18:00
31-07-1990	08:30 - 24:00
01-08-1990	10:30 - 17:00
02-08-1990	02:00 - 14:30
03-08-1990	08:30 - 12:30
06-08-1990	09:00 - 17:00
07-08-1990	09:30 - 16:00
08-08-1990	02:45 - 12:00
09-08-1990	09:30 - 16:00

3

RESULTS

All data presented in figures 3.1a - 3.4i are values averaged over 15 minutes.

Irradiation data on 5 sides of the cube are shown in figures 3.1a - 3.1i. Irradiation data on boards with elevation angles of 90, 60 and 30 degrees are shown in figures 3.2a - 3.2b. Temperature, relative humidity, windspeed and radiation measured by solarimeter are shown in figures 3.3a - 3.3i. Apparent temperatures of a vertical white and black board are presented together with ambient temperature in figures 3.4a - 3.4i.

Plotted meteo data are presented in appendix A. Differences between plotted data and stored data on a PC are caused by different average times.

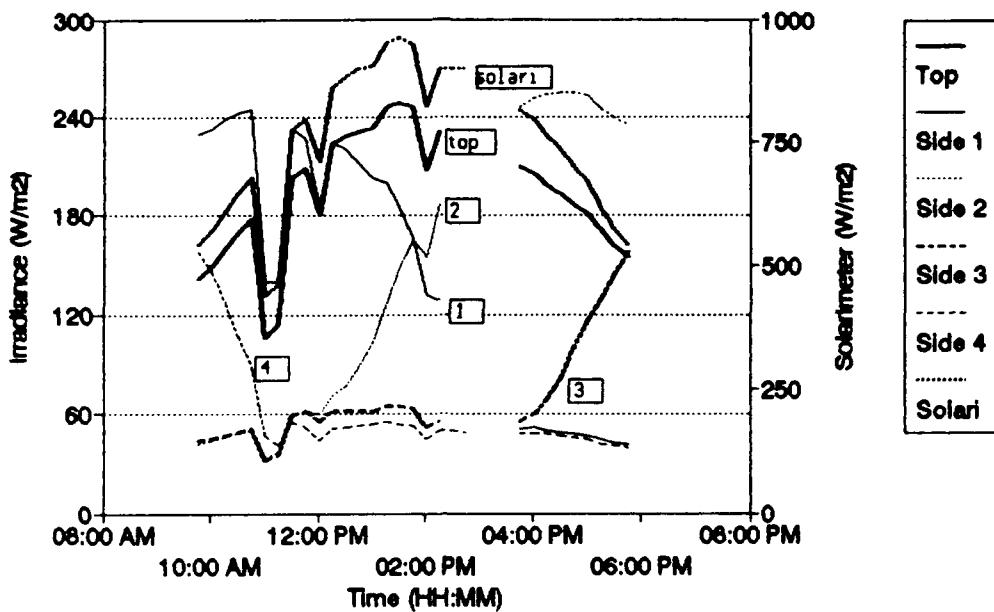


Fig 3.1a: Irradiation at five sides of a box; 30-07-1990.

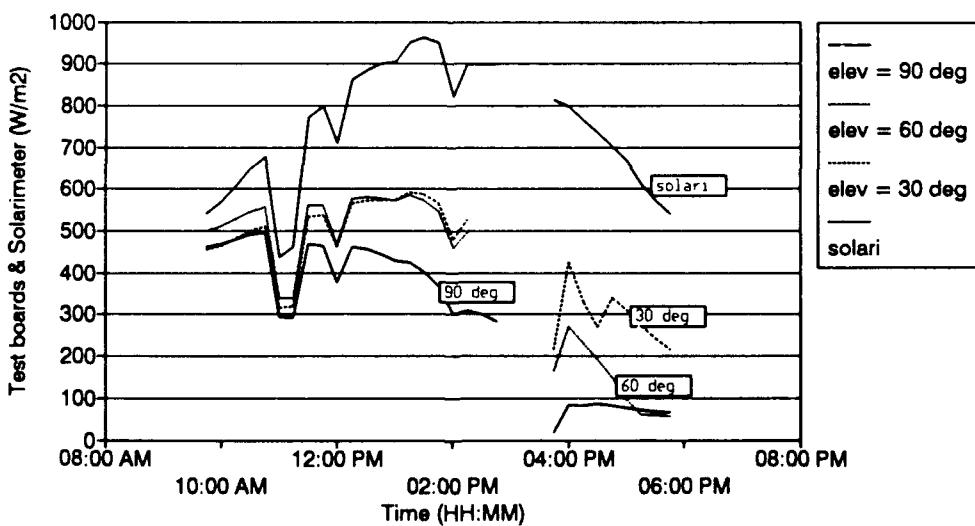


Fig 3.2a: Irradiation on boards with elevation angles of 90, 60 and 30 degrees; 30-07-1990.

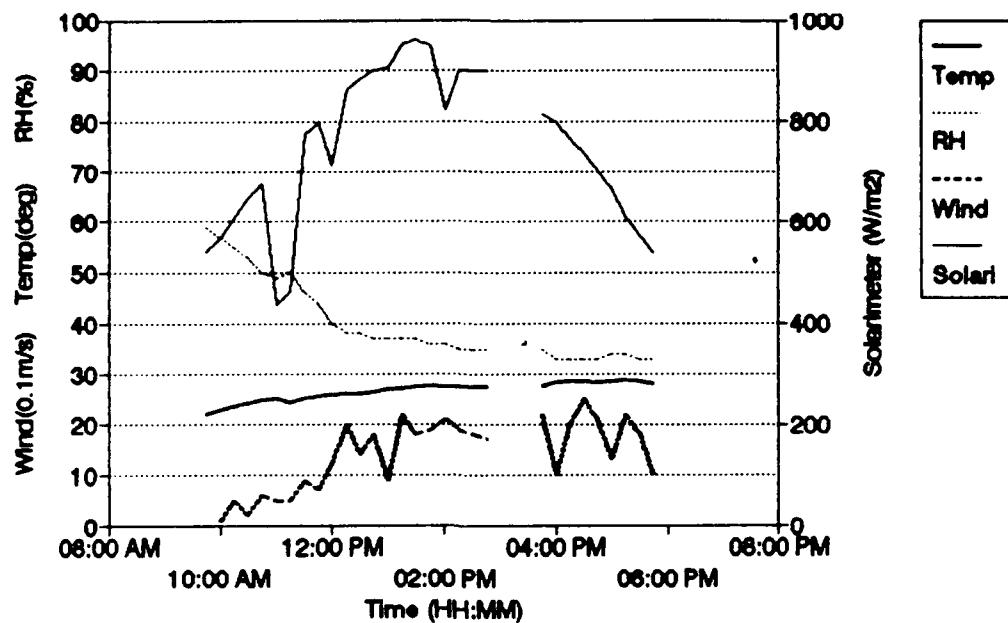


Fig 3.3a: Temperature, relative humidity, windspeed and hemispherical radiation; 30-07-1990.

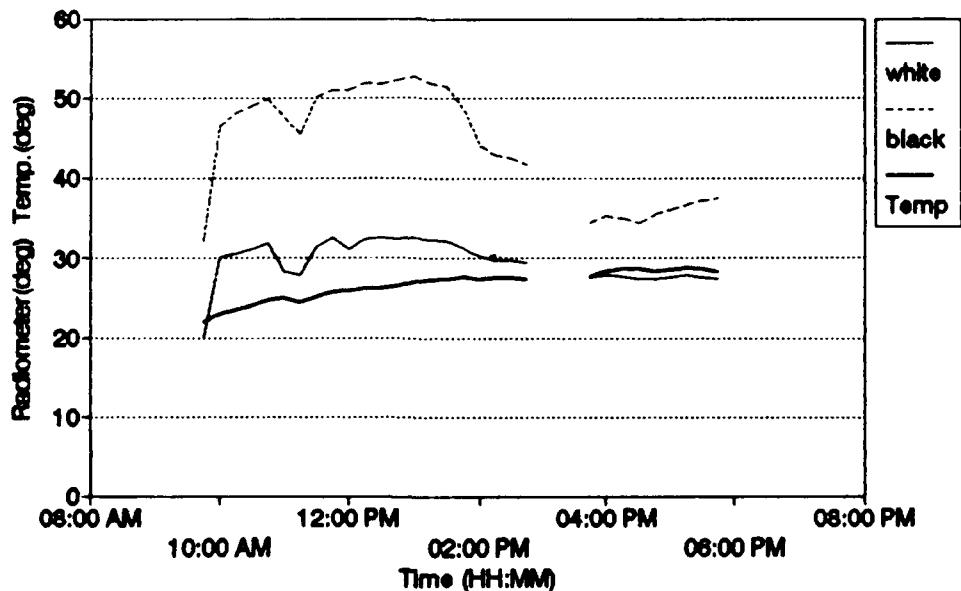


Fig 3.4a: Apparent temperature of vertical black and white board, ambient temperature; 30-07-1990.

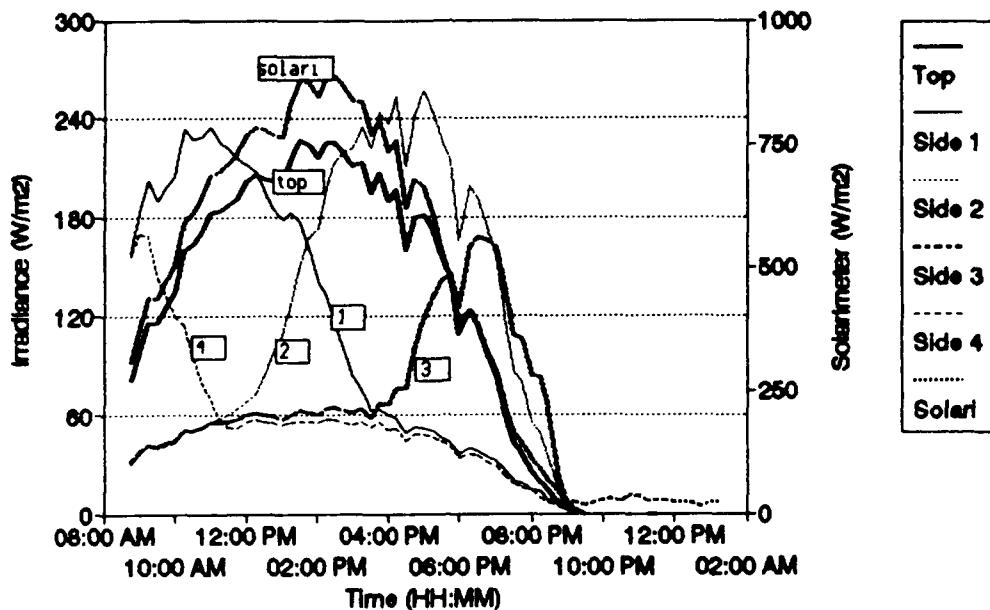


Fig 3.1b: Irradiation at five sides of a box; 31-07-1990.

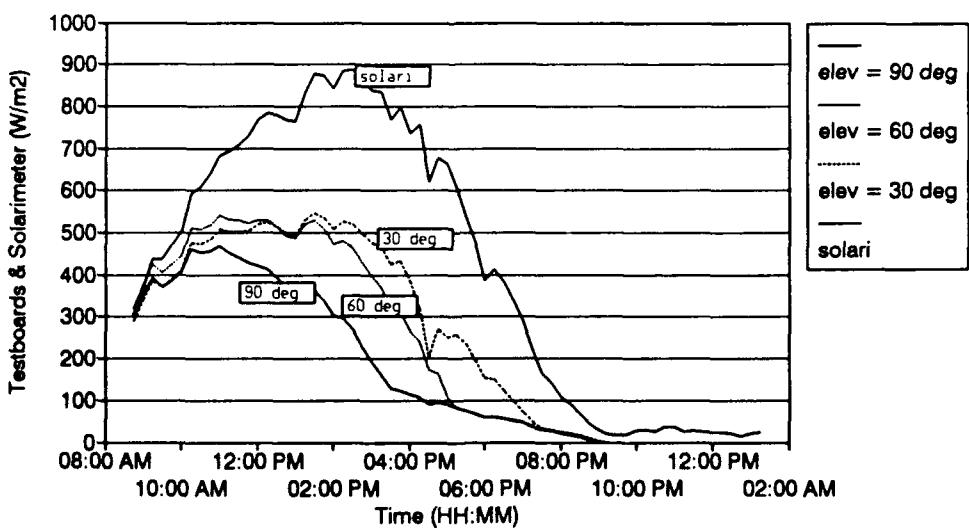


Fig 3.2b: Irradiation on boards with elevation angles of 90, 60 and 30 degrees; 31-07-1990.

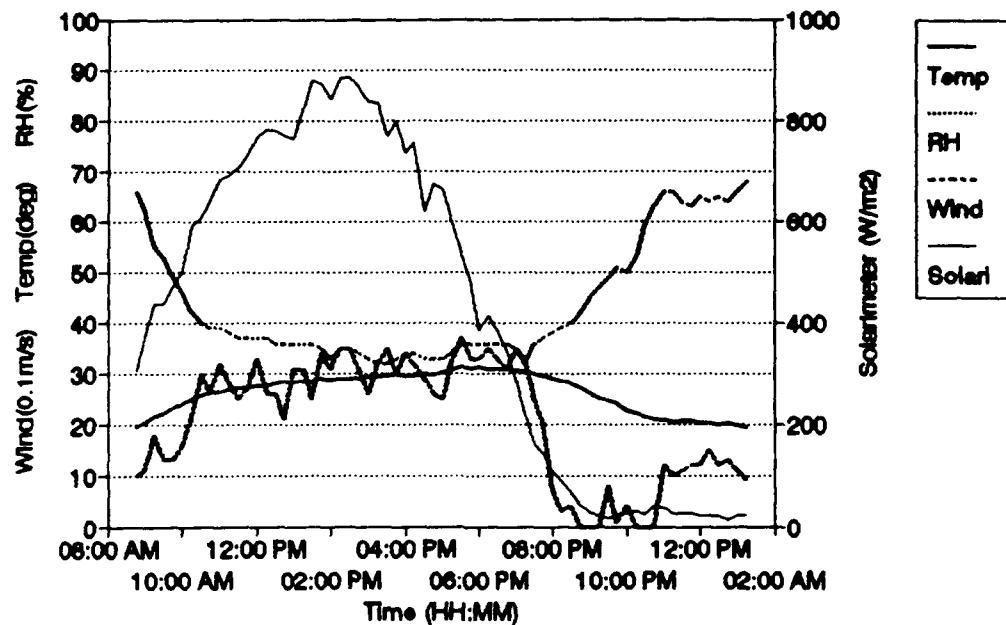


Fig 3.3b: Temperature, relative humidity, windspeed and hemispherical radiation; 31-07-1990.

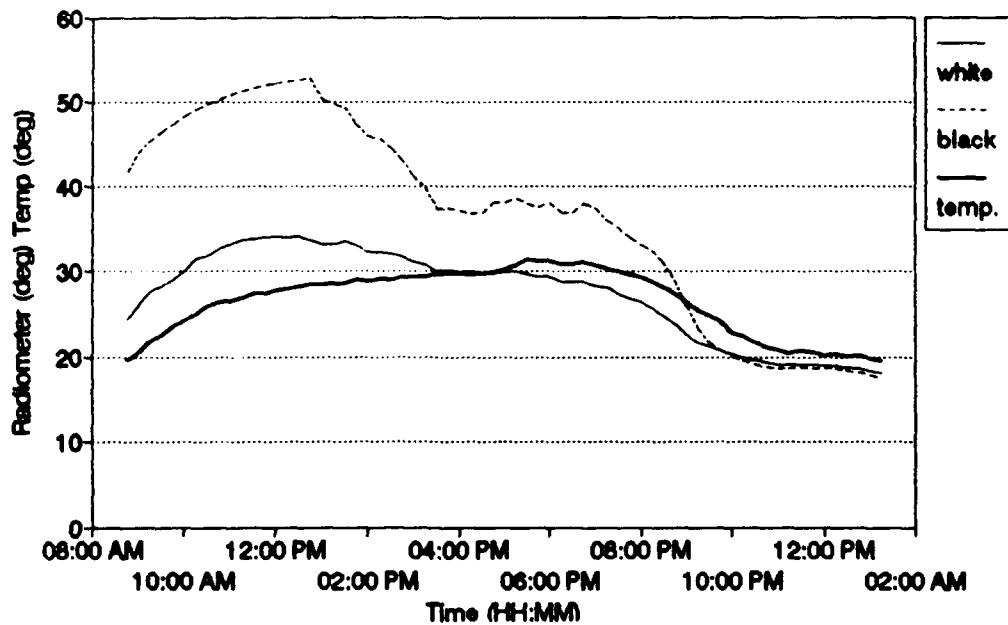


Fig 3.4b: Apparent temperature of vertical black and white board, ambient temperature; 31-07-1990.

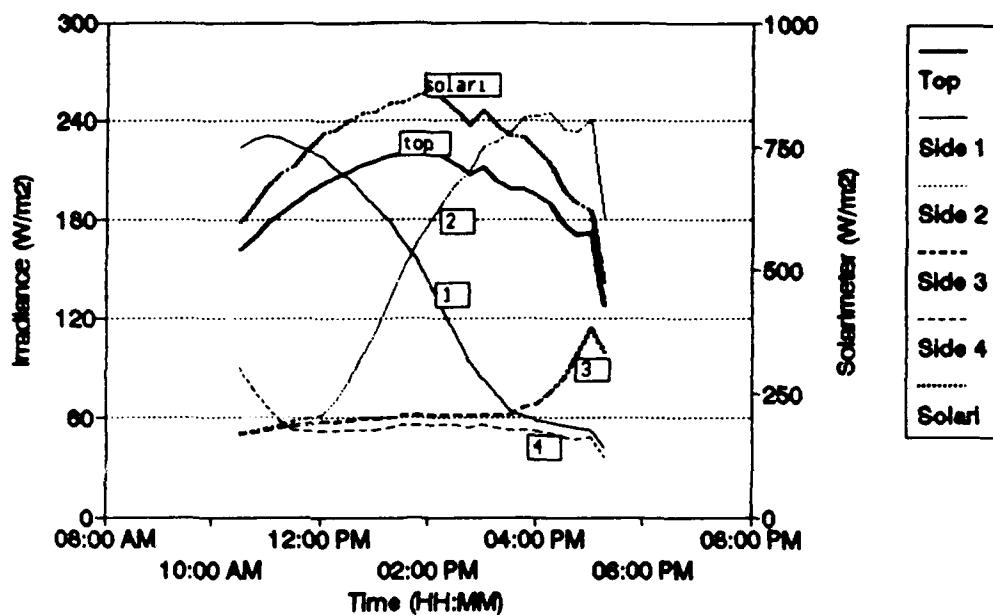


Fig 3.1c: Irradiation at five sides of a box; 01-08-1990.

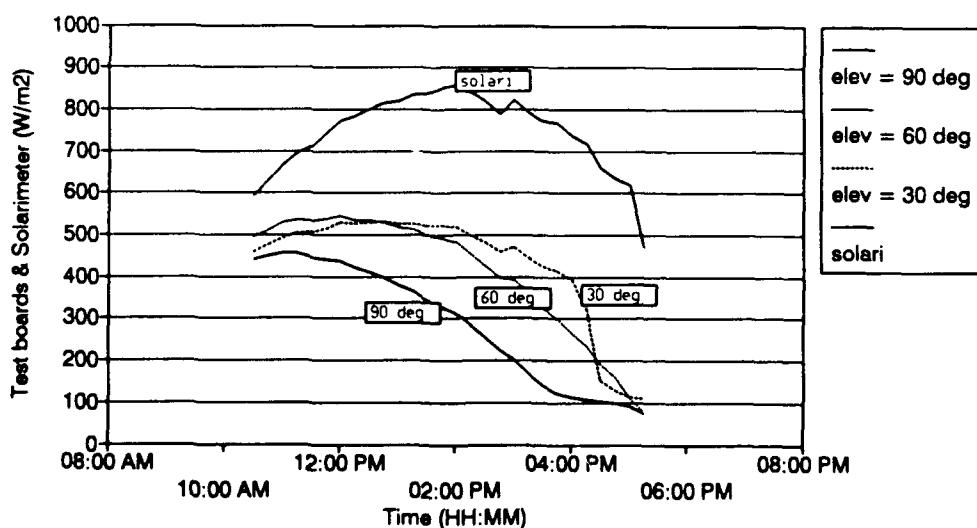


Fig 3.2c: Irradiation on boards with elevation angles of 90, 60 and 30 degrees; 01-08-1990.

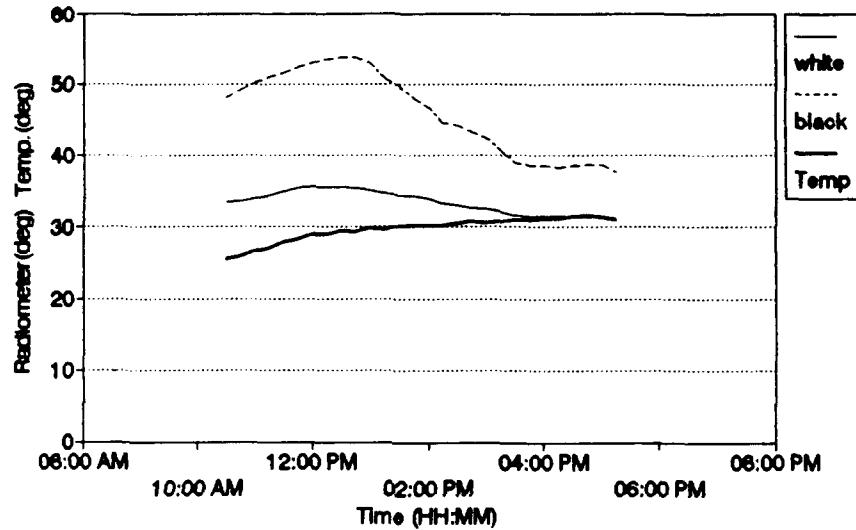


Fig 3.3c: Temperature, relative humidity, windspeed and hemispherical radiation; 01-08-1990.

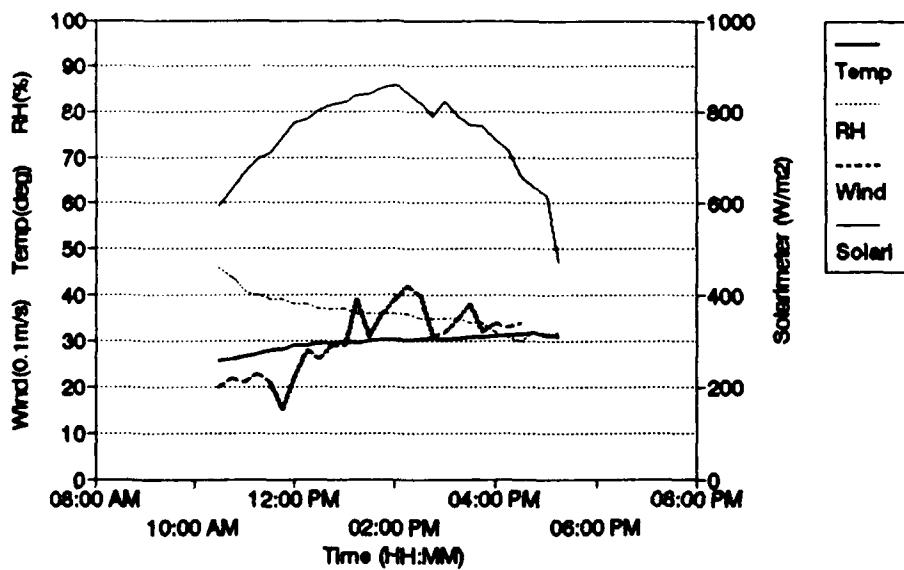


Fig 3.4c: Apparent temperature of vertical black and white board, ambient temperature; 01-08-1990.

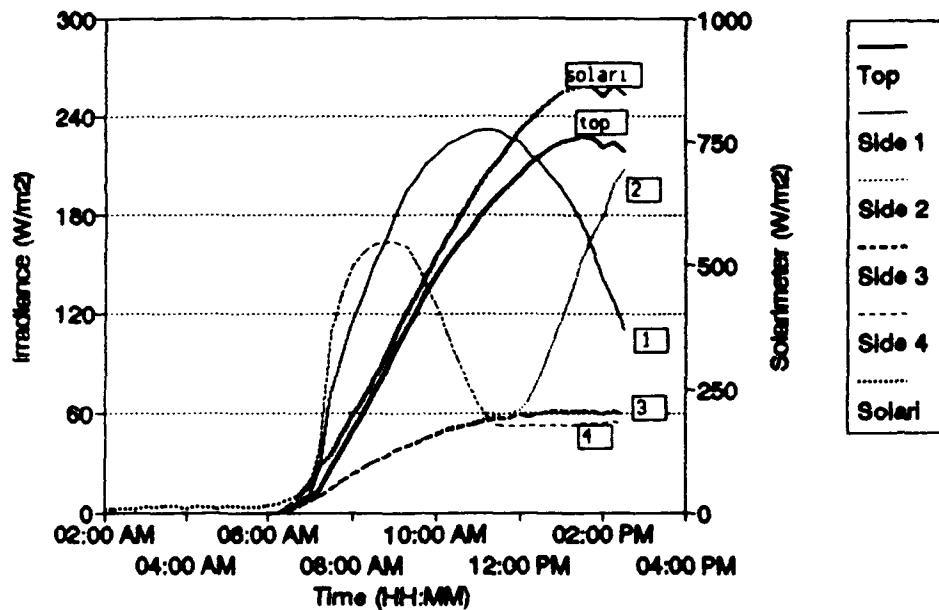


Fig 3.1d: Irradiation at five sides of a box; 02-08-1990.

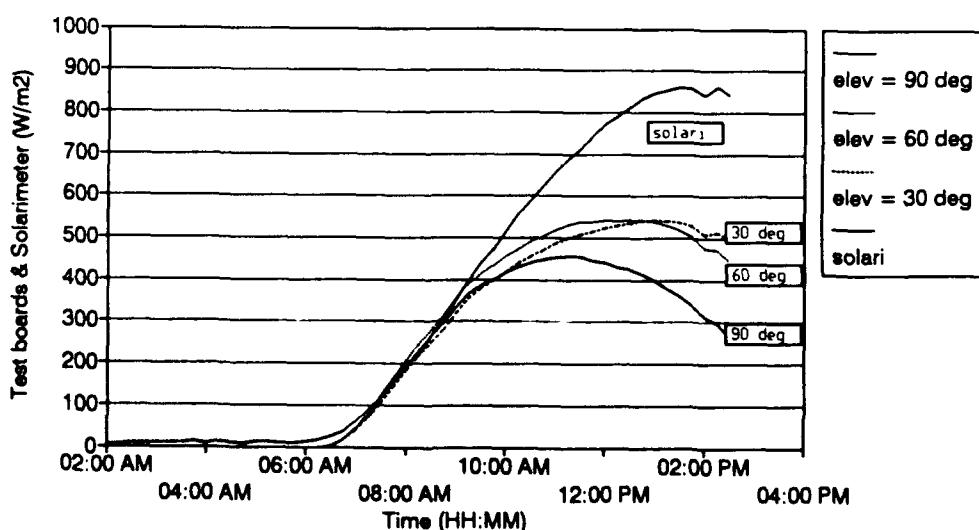


Fig 3.2d: Irradiation on boards with elevation angles of 90, 60 and 30 degrees; 02-08-1990.

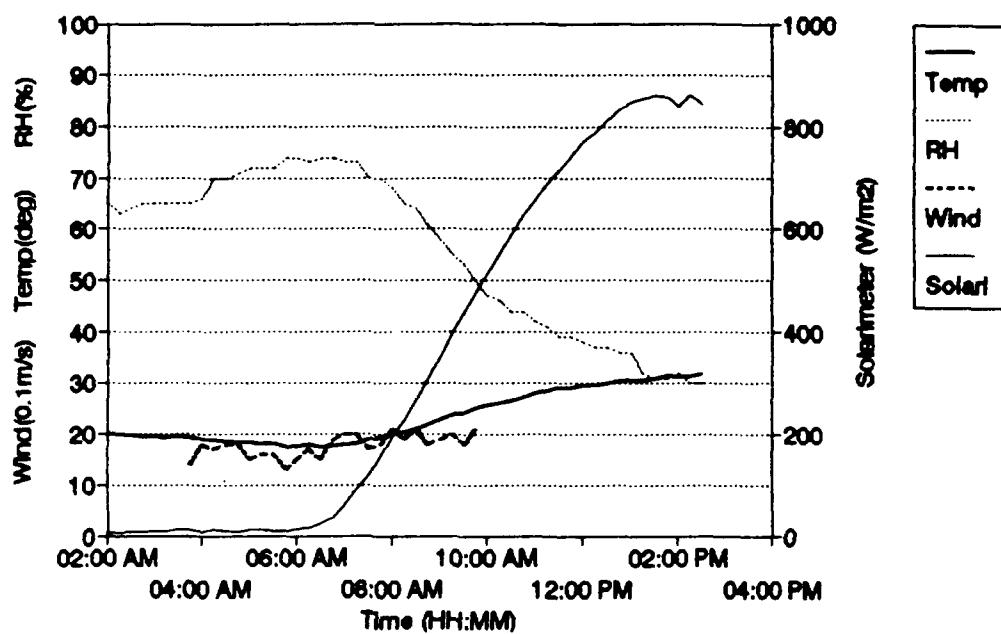


Fig 3.3d: Temperature, relative humidity, windspeed and hemispherical radiation; 02-08-1990.

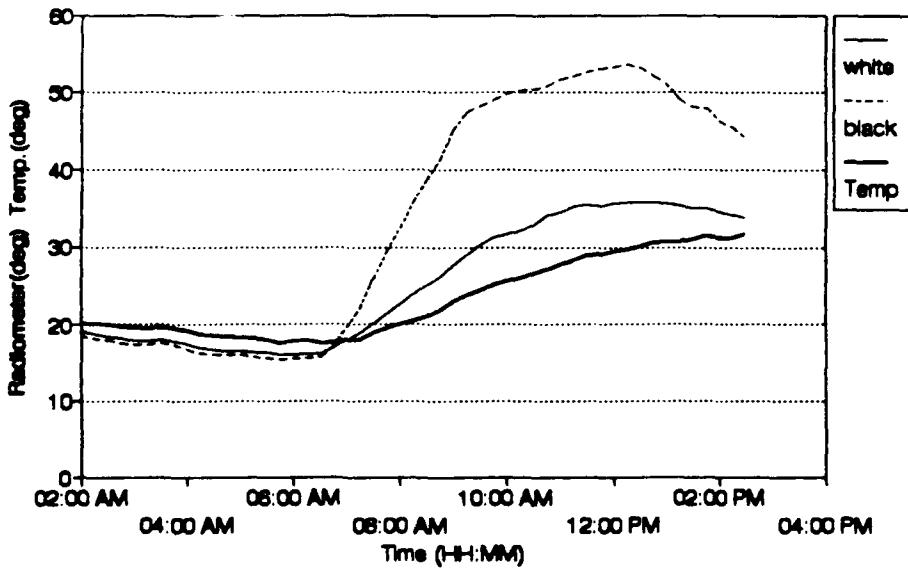


Fig 3.4d: Apparent temperature of vertical black and white board, ambient temperature; 02-08-1990.

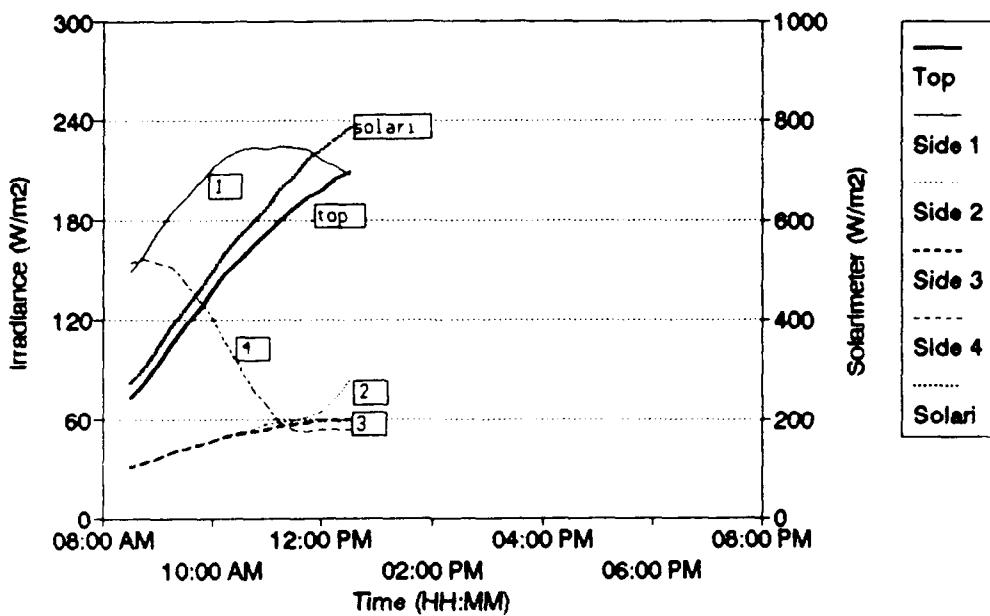


Fig 3.1e: Irradiation on five sides of a box; 03-08-1990.

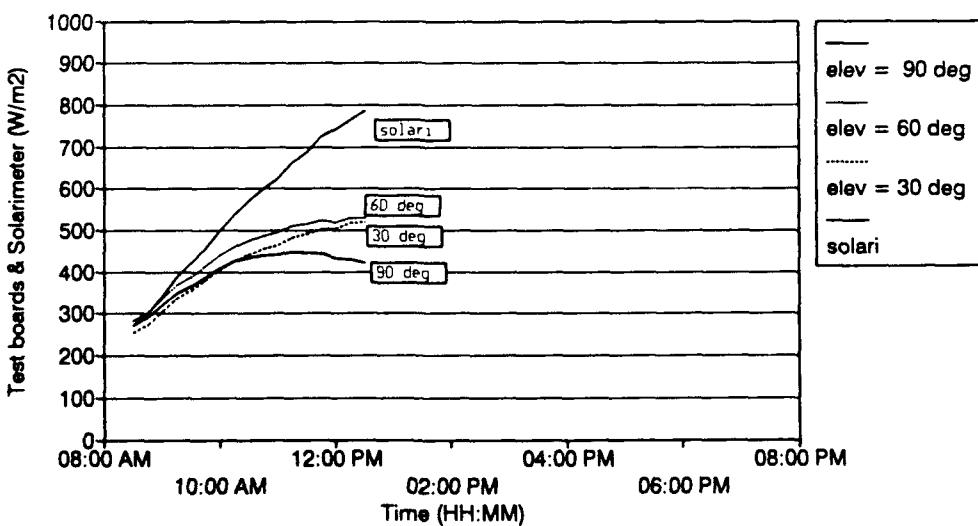


Fig 3.2e: Irradiation on boards with elevation angles of 90, 60 and 30 degrees; 03-08-1990.

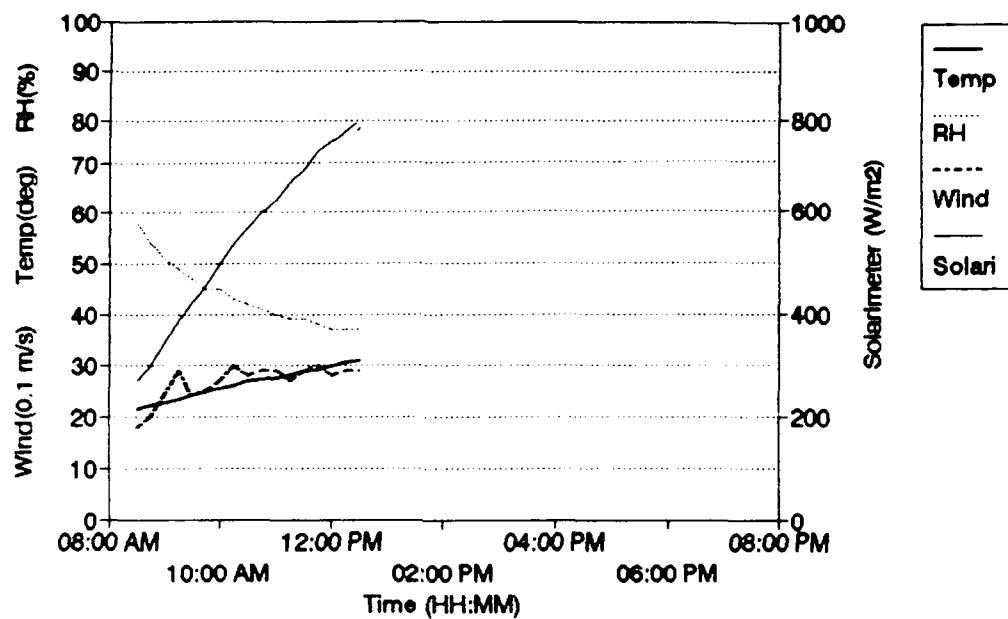


Fig 3.3e: Temperature, relative humidity, windspeed and hemispherical radiation; 03-08-1990.

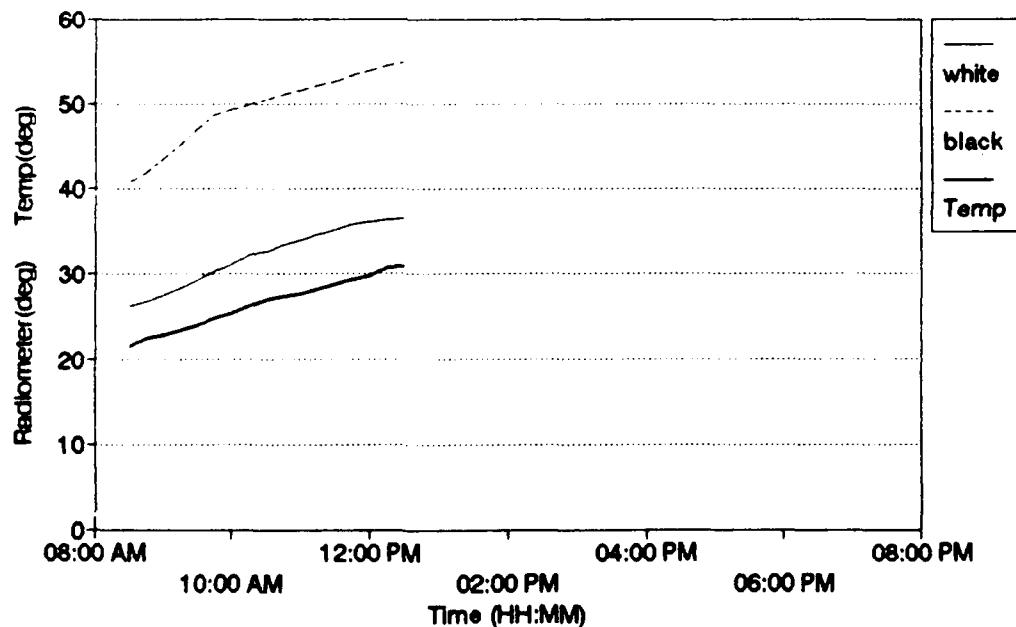


Fig 3.4e: Apparent temperature of vertical black and white board, ambient temperature; 03-08-1990.

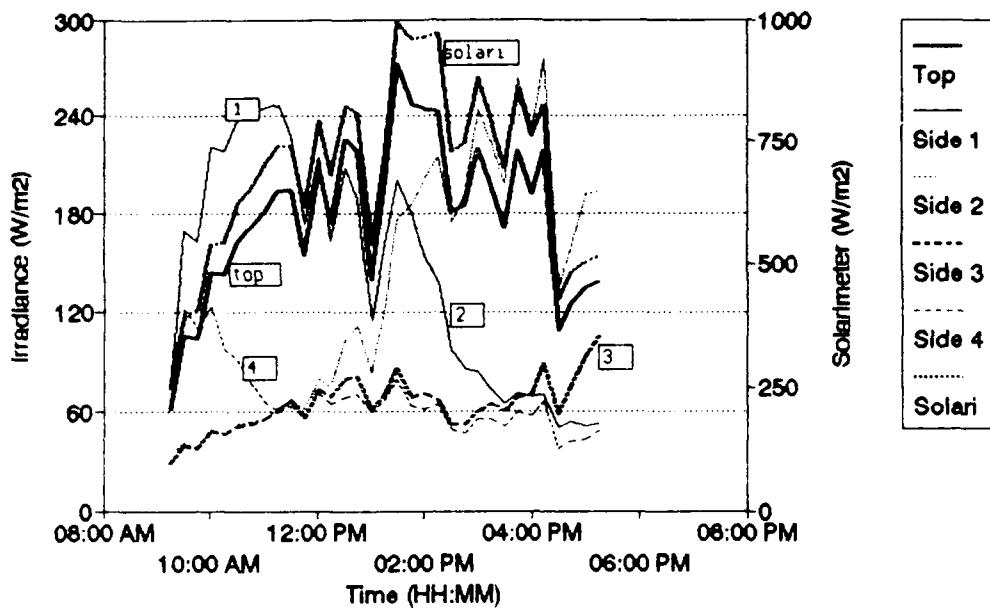


Fig 3.1f: Irradiation at five sides of a box; 06-08-1990.

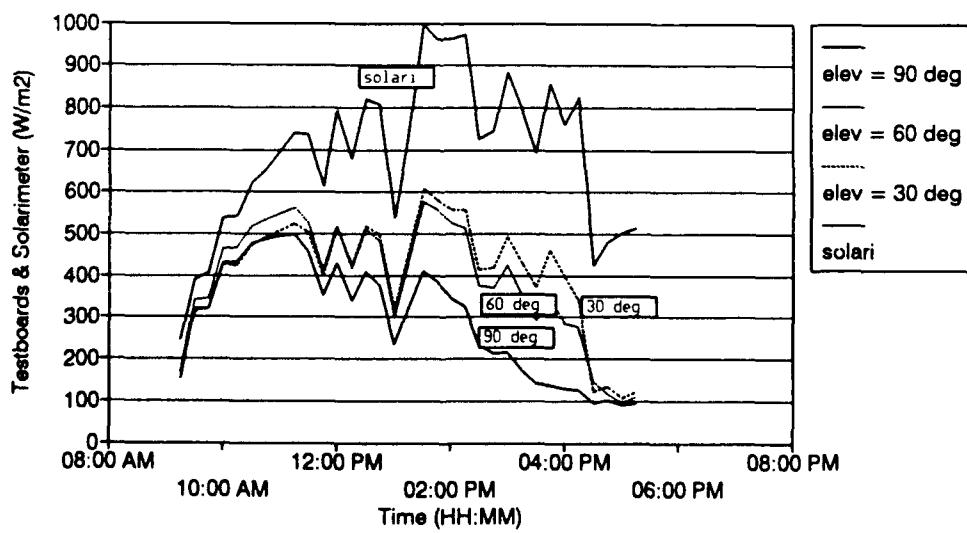


Fig 3.2f: Irradiation on boards with elevation angles of 90, 60 and 30 degrees; 06-08-1990.

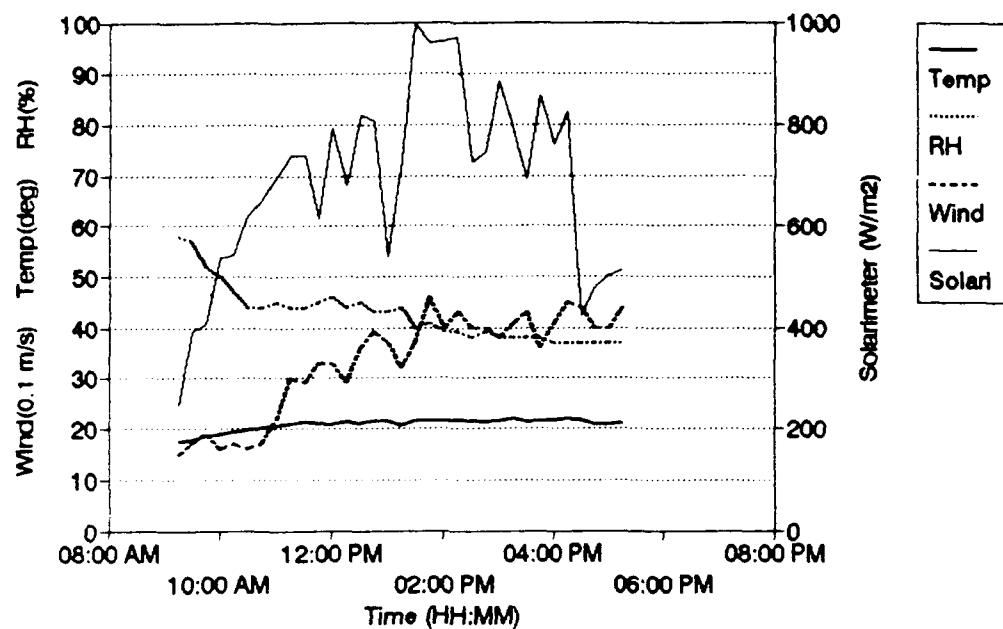


Fig 3.3f: Temperature, relative humidity, windspeed and hemispherical radiation; 06-08-1990.

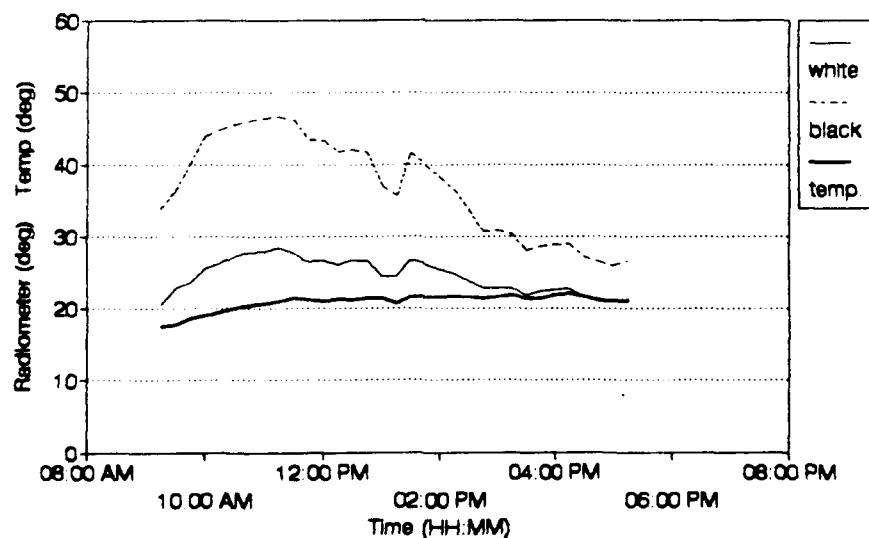


Fig 3.4f: Apparent temperature of vertical black and white board, ambient temperature; 06-08-1990.

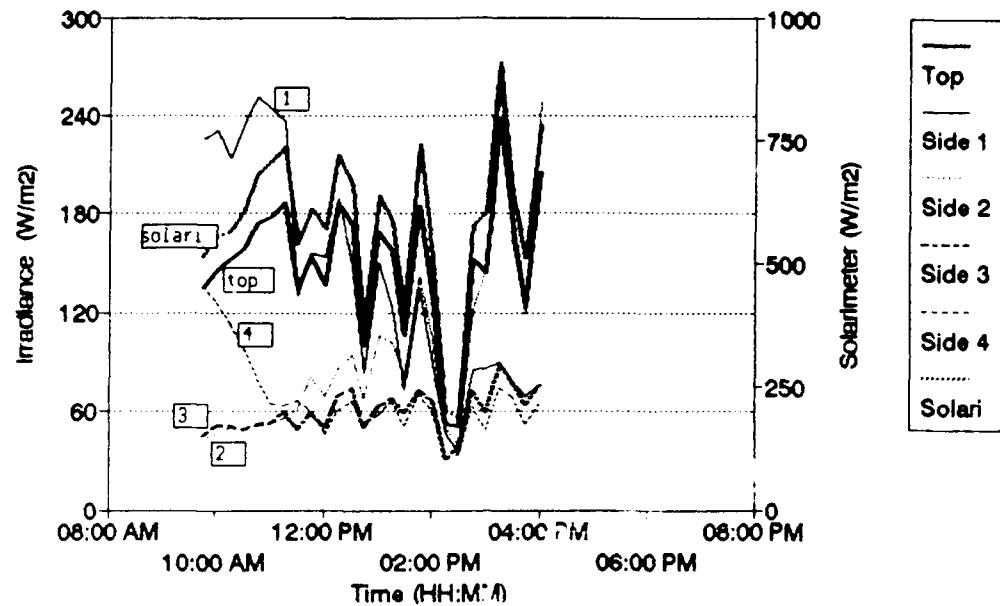


Fig 3.1g: Irradiation at five sides of a box; 07-08-1990.

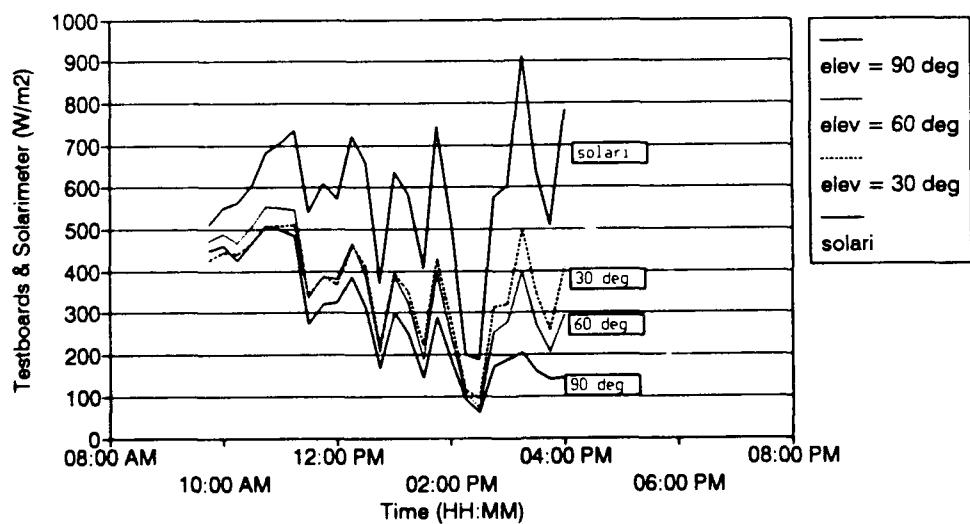


Fig 3.2g: Irradiation on boards with elevation angles of 90, 60 and 30 degrees; 07-08-1990.

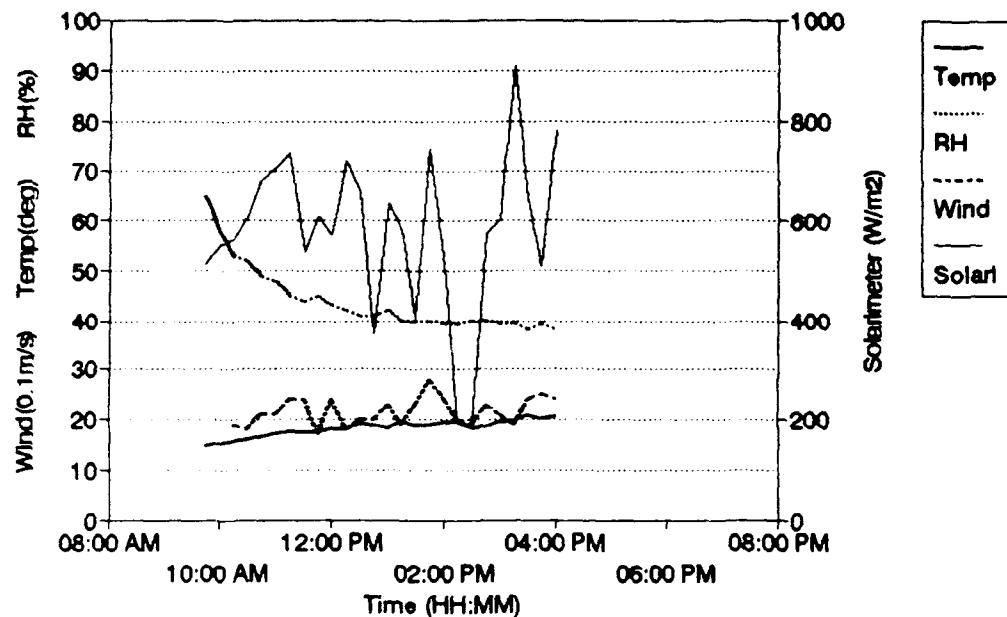


Fig 3.3g: Temperature, relative humidity, windspeed and hemispherical radiation; 07-08-1990.

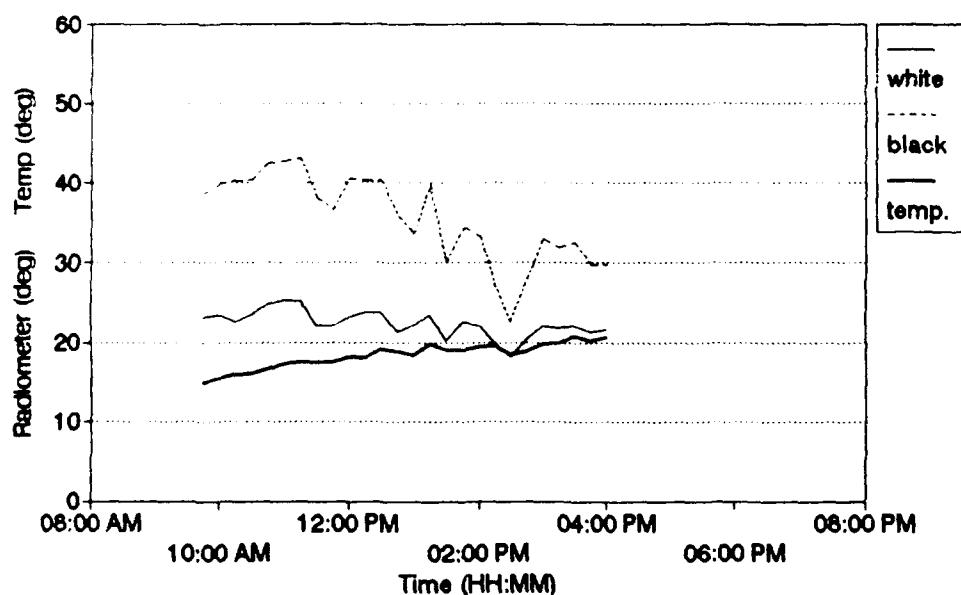


Fig 3.4g: Apparent temperature of vertical black and white board, ambient temperature; 07-08-1990.

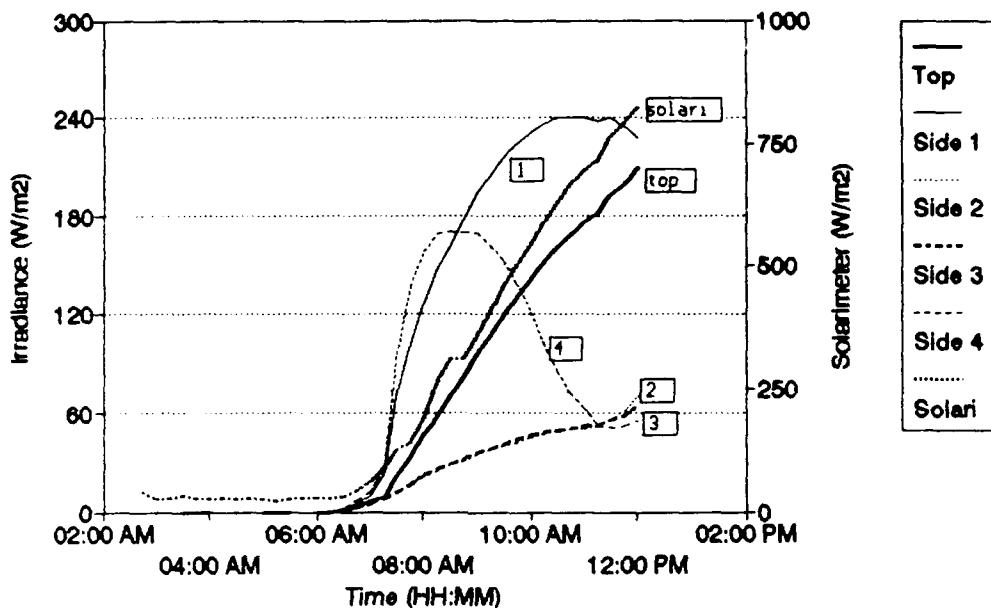


Fig 3.1h: Irradiation at five sides of a box; 08-08-1990.

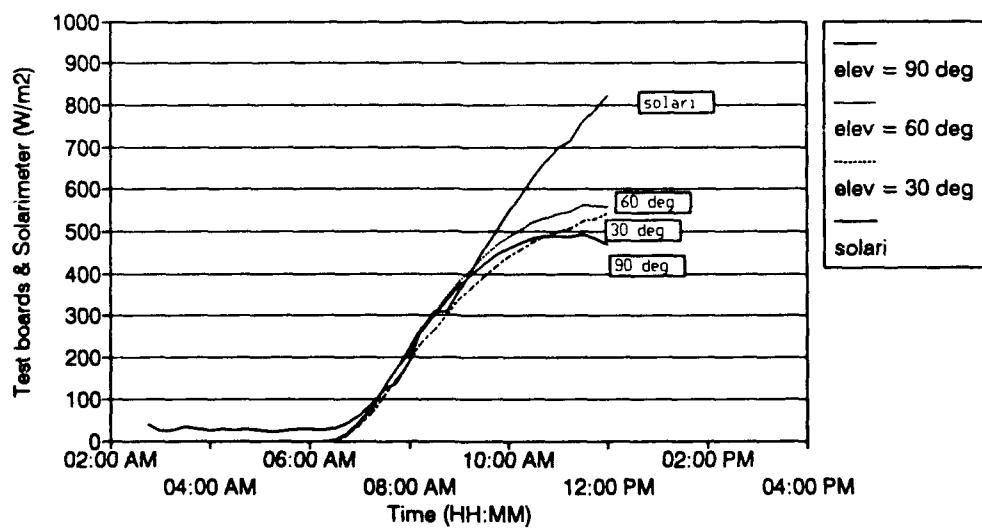


Fig 3.2h: Irradiation on boards with elevation angles of 90, 60 and 30 degrees; 08-08-1990.

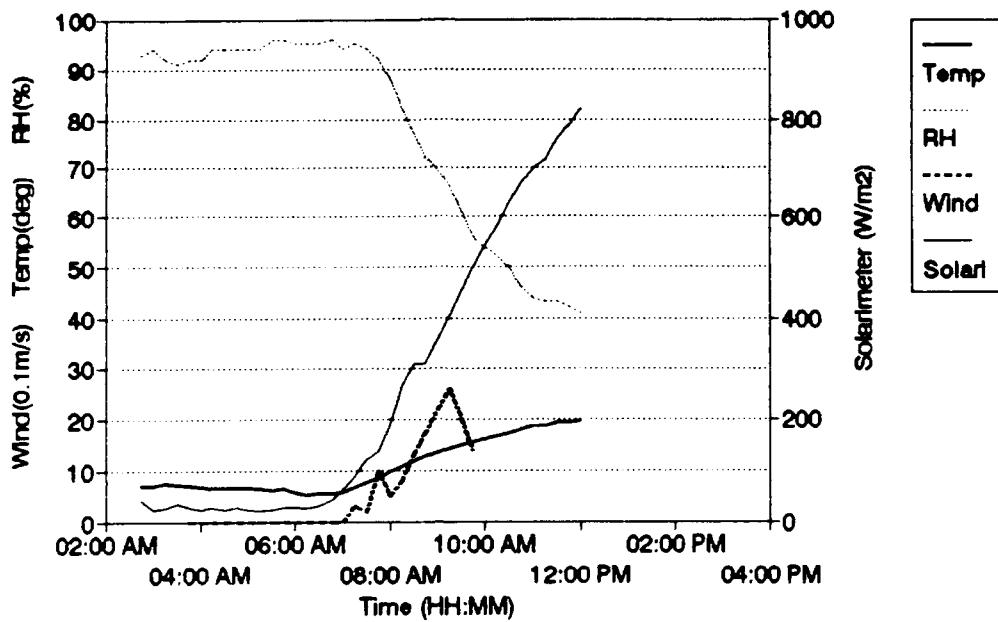


Fig 3.3h: Temperature, relative humidity, windspeed and hemispherical radiation; 08-08-1990.

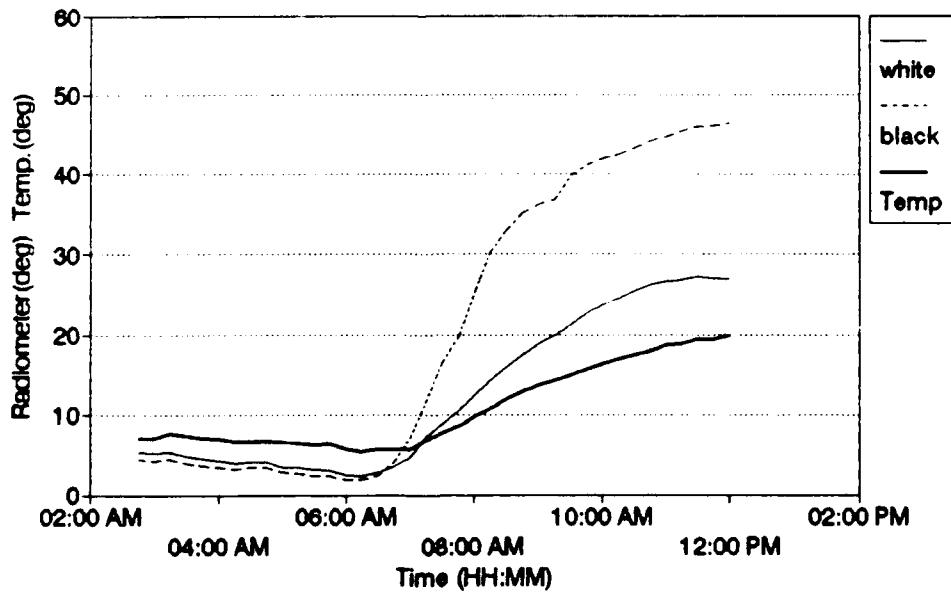


Fig 3.4h: Apparent temperature of vertical black and white board, ambient temperature; 08-08-1990.

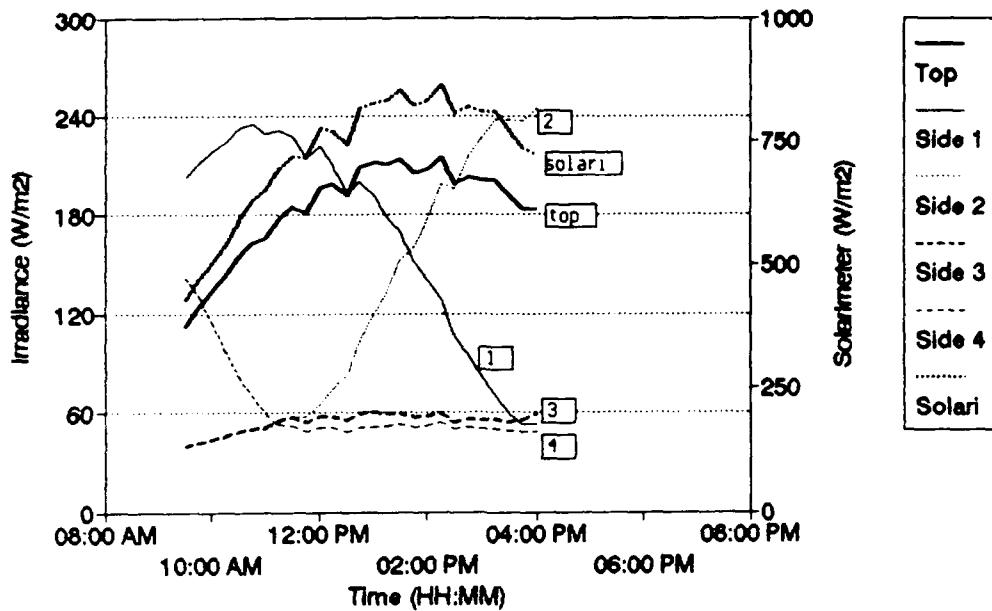


Fig 3.1i: Irradiation at five sides of a box; 09-08-1990.

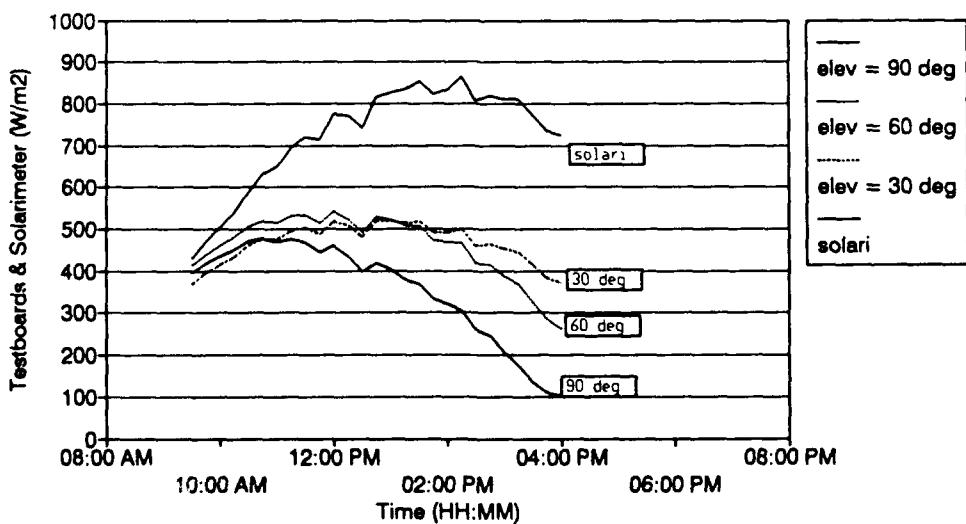


Fig 3.2i: Irradiation on boards with elevation angles of 90, 60 and 30 degrees; 09-08-1990.

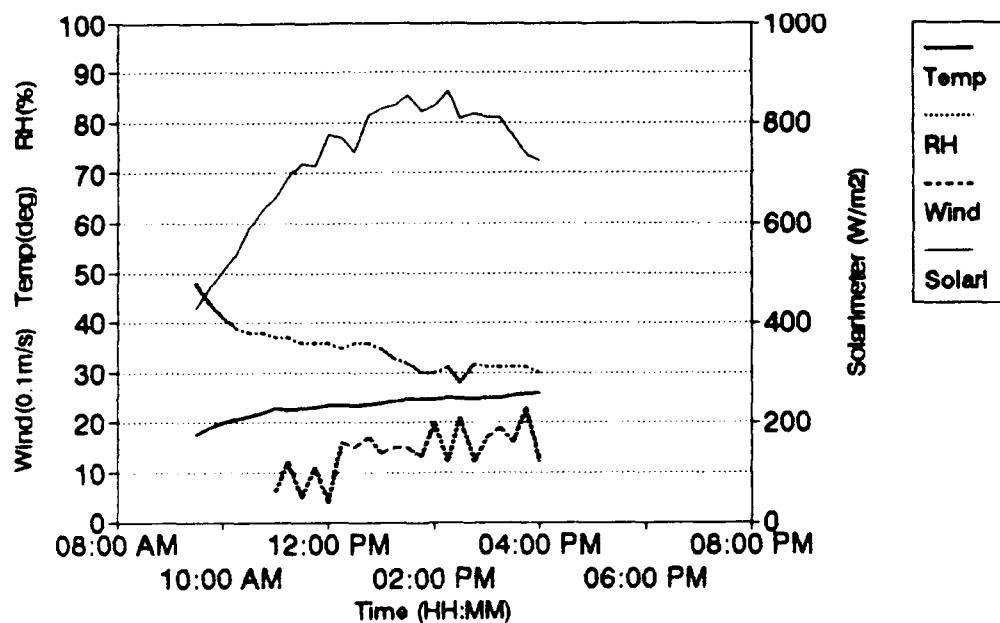


Fig 3.3i: Temperature, relative humidity, windspeed and hemispherical radiation; 09-08-1990.

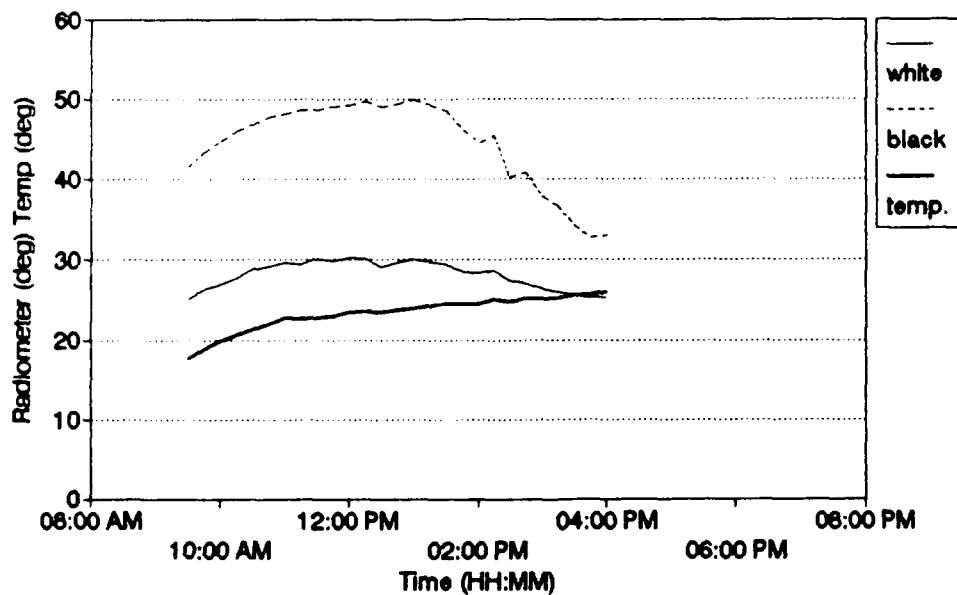
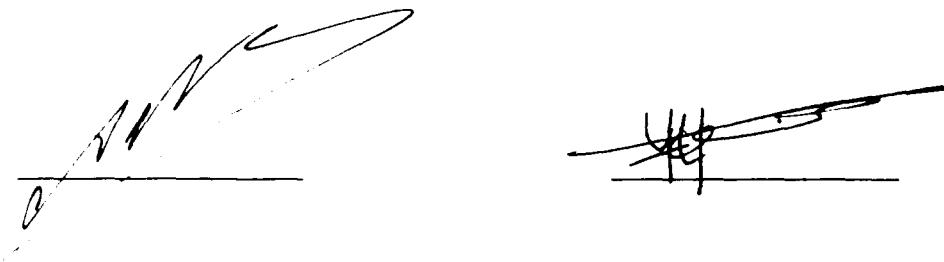


Fig 3.4i: Apparent temperature of vertical black and white board, ambient temperature; 09-08-1990.

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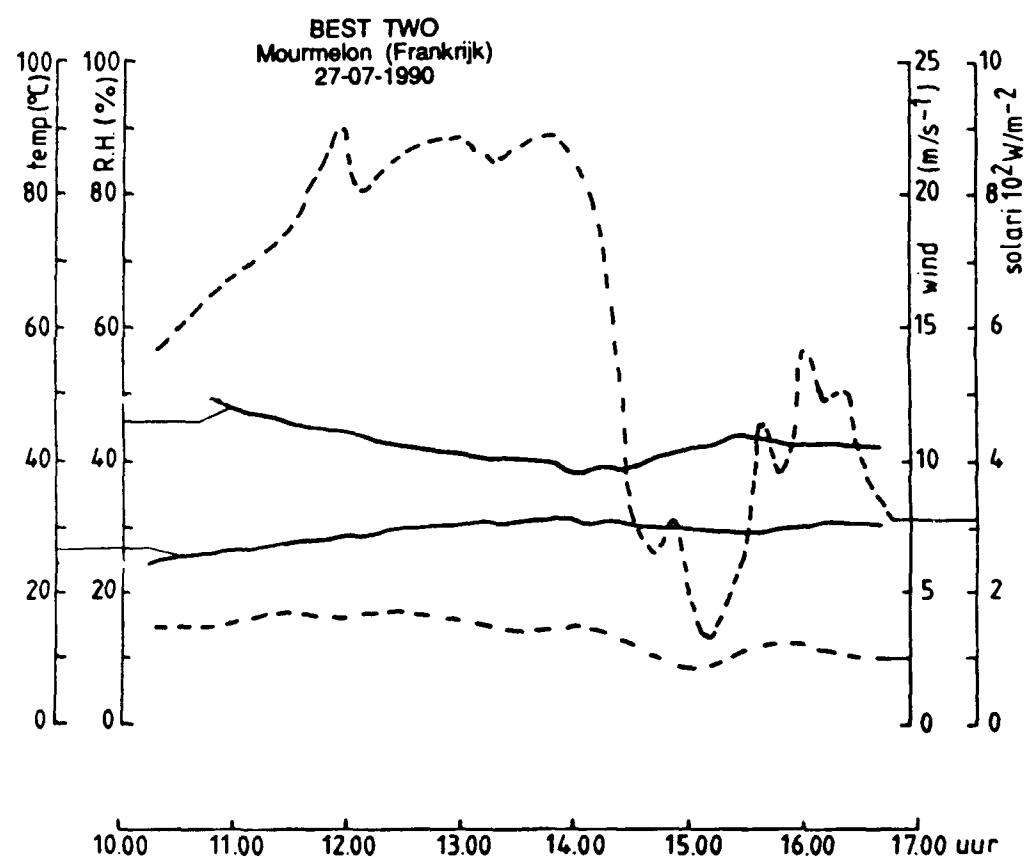
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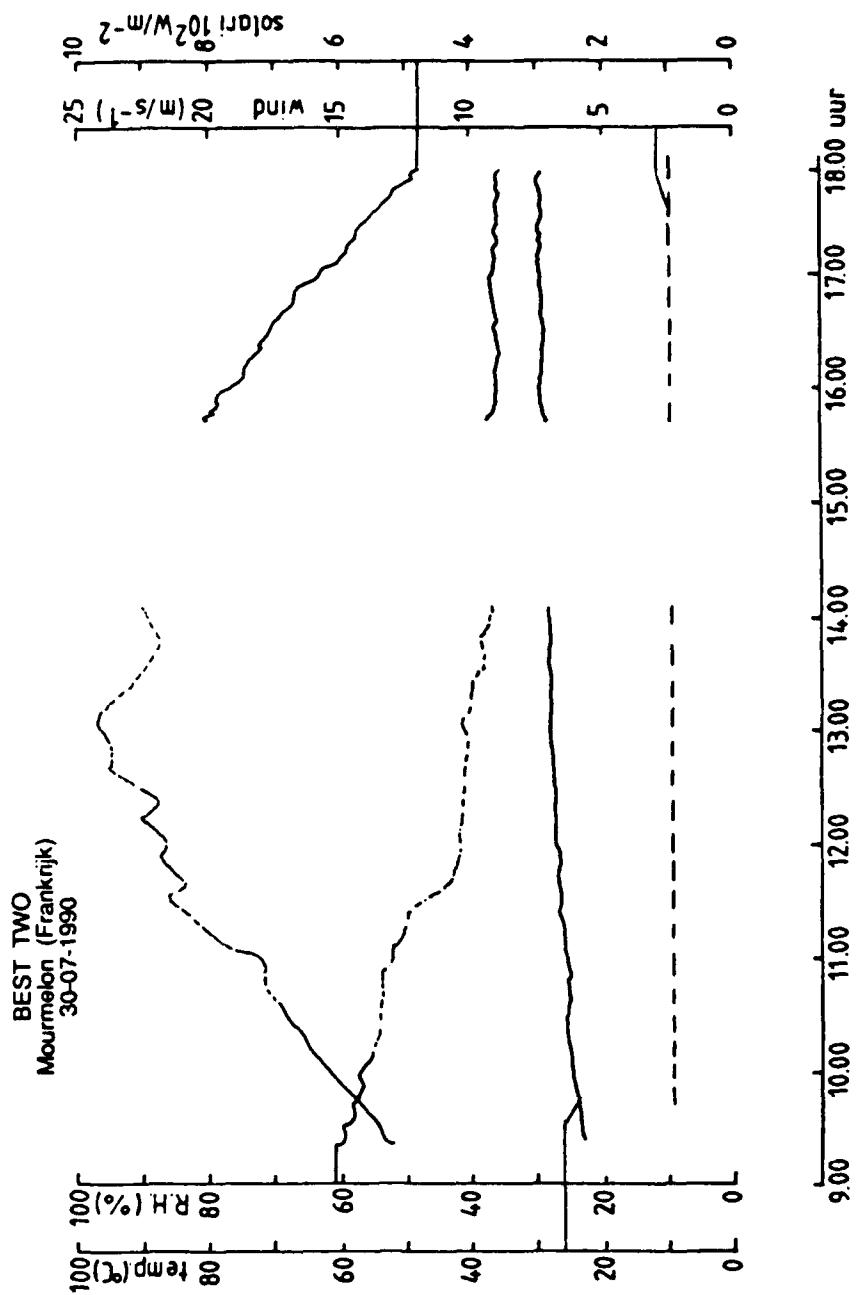
- [1] BES90: Bestley B.; **BEST TWO TESTPLAN**; Battlefield effects on long range (4 km) target acquisition; Camp Mourmelon (France), 23 July - 17 August 1990; NATO AC/243(panel 4/RSG 15), January 1990
- [2] DRE: Drese J.Th.; mobiel weerstation FEL

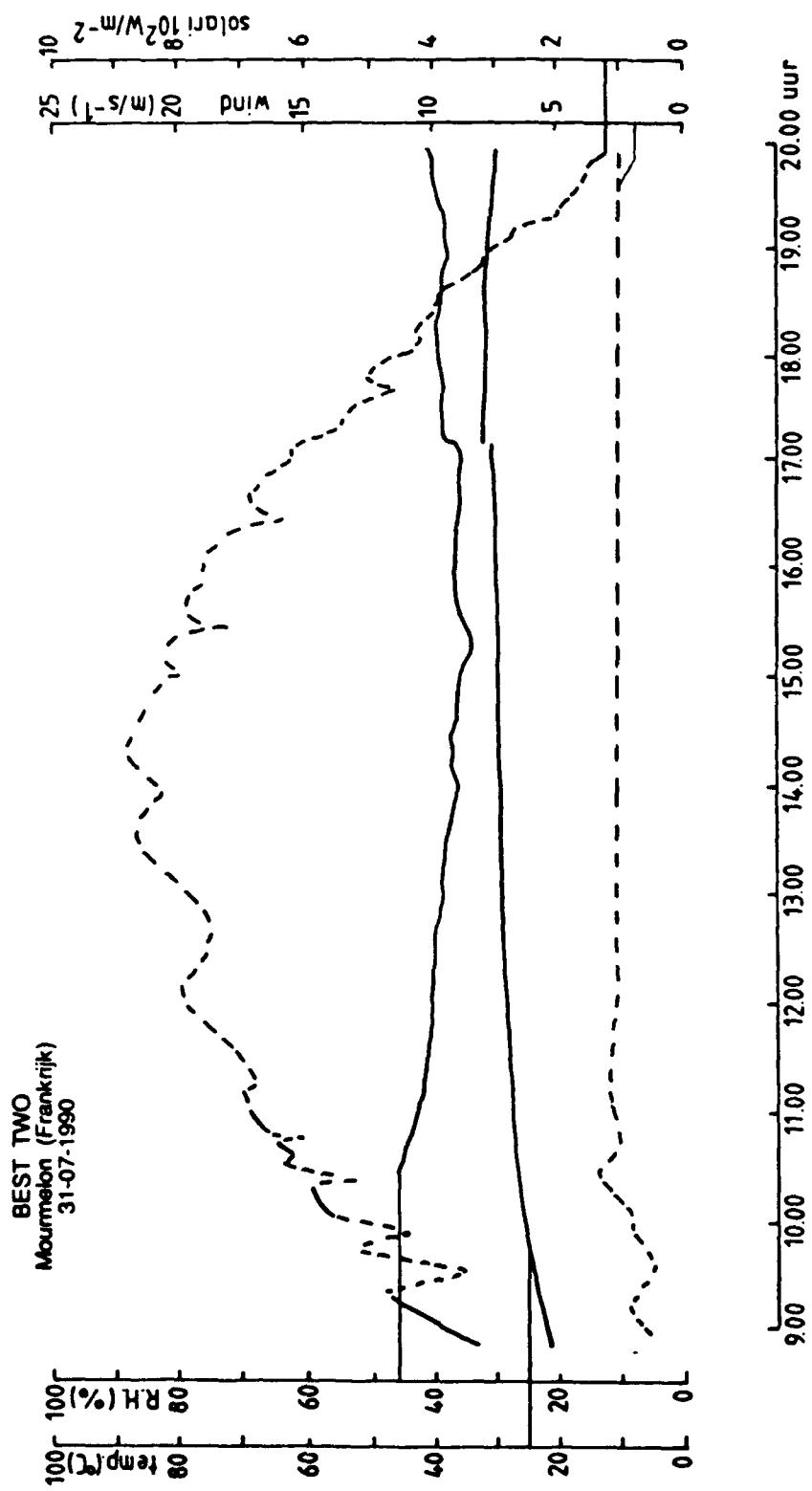


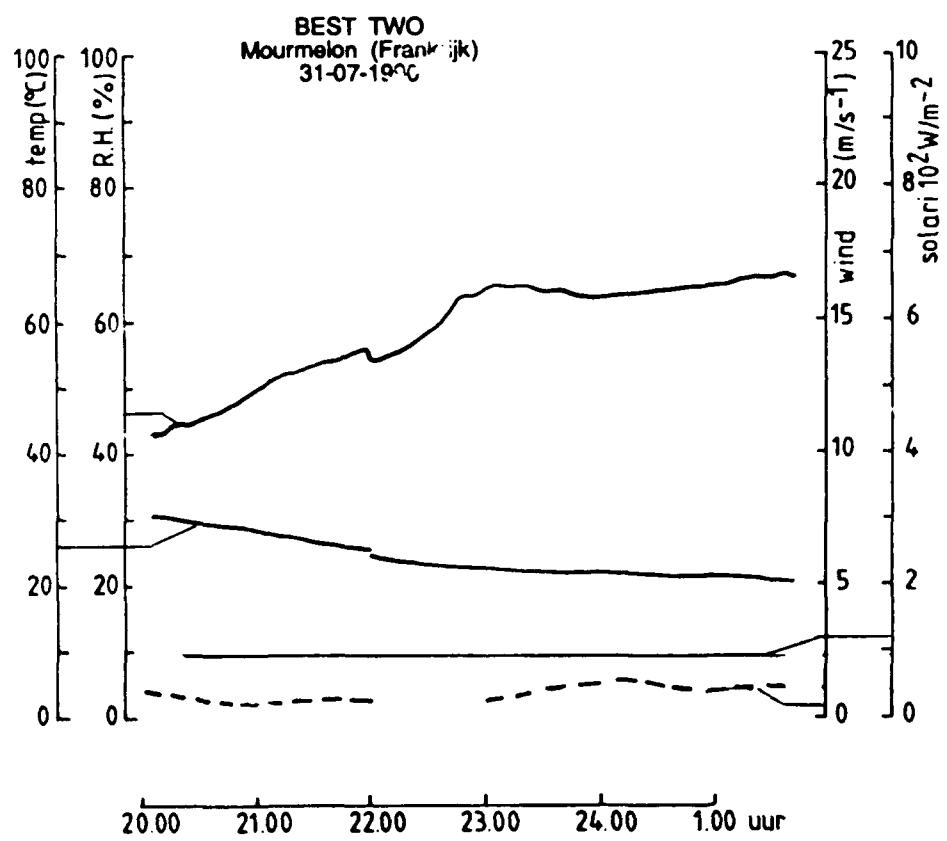
Ir. A.N. de Jong
(Group Leader)

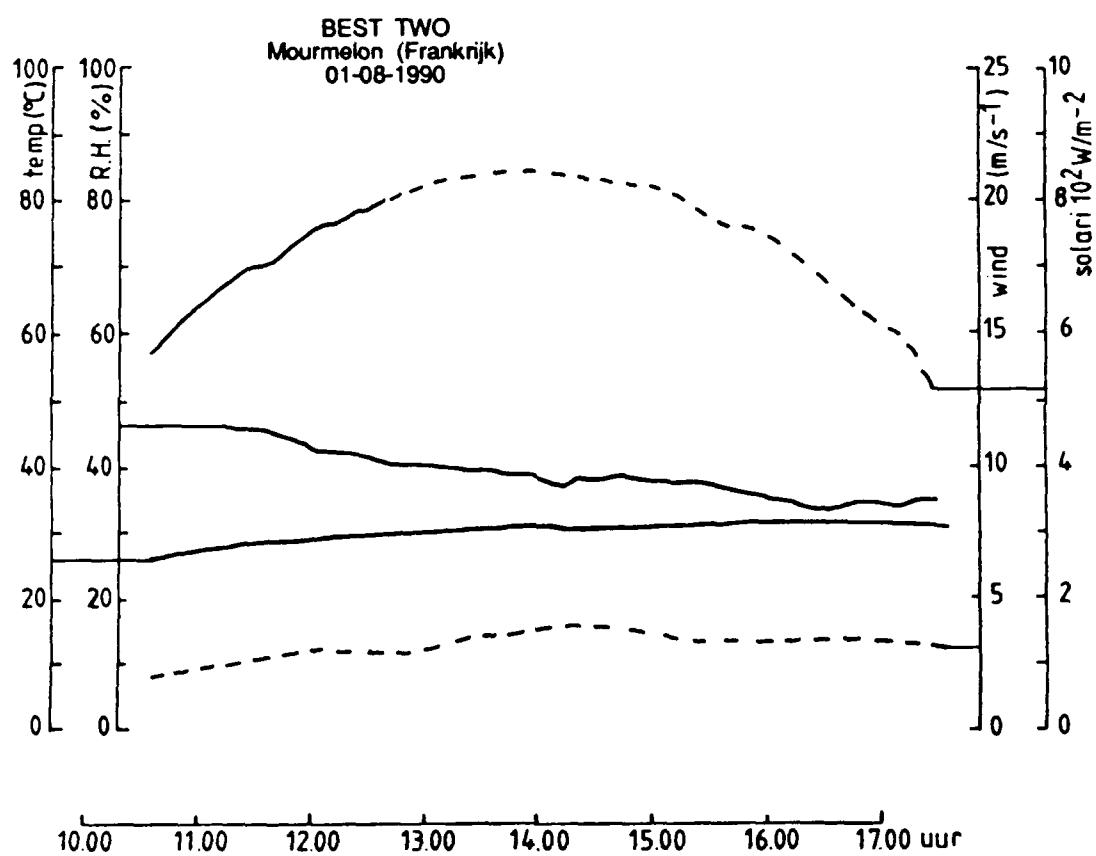
Ir. Y.H.L. Janssen
(Author)

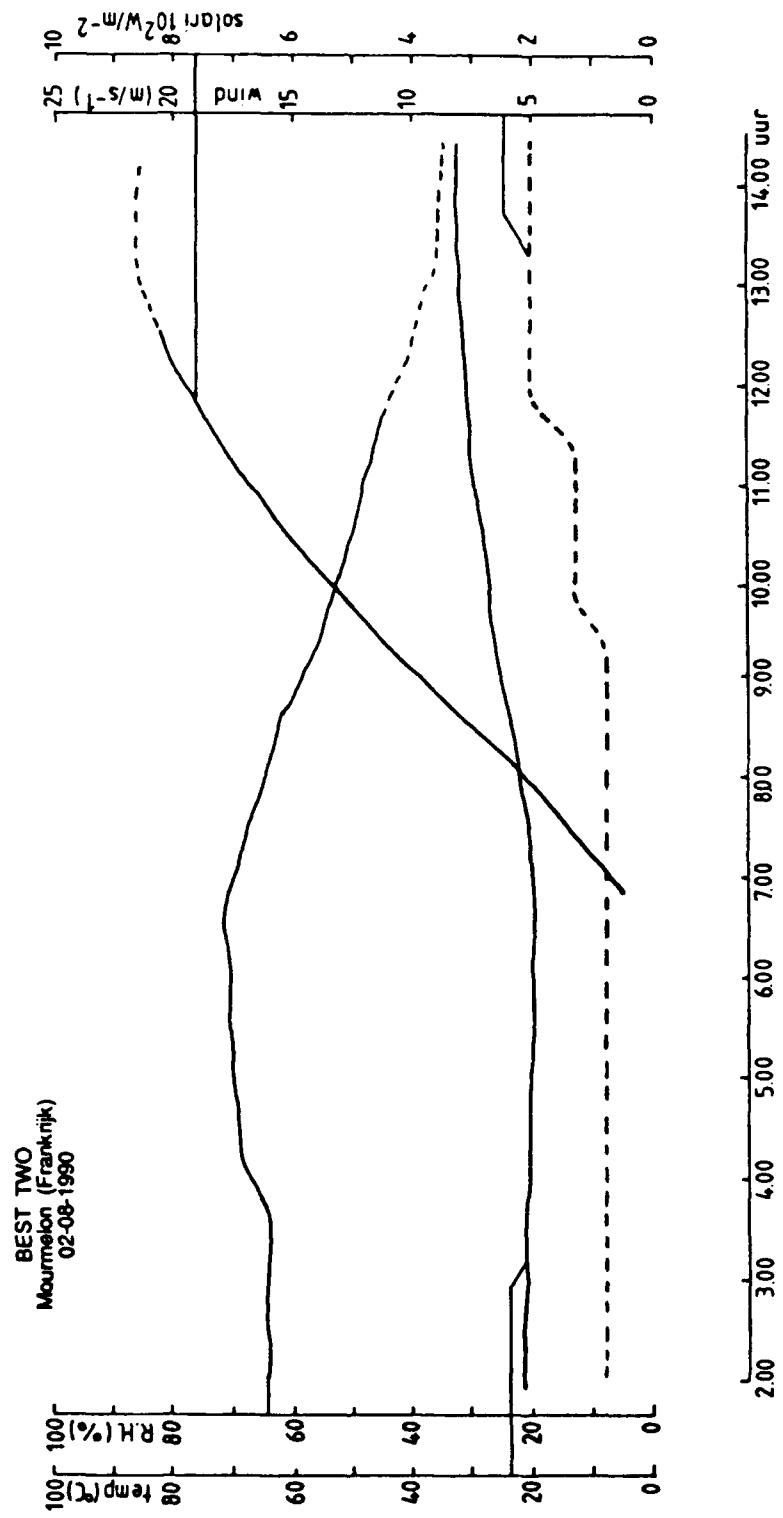


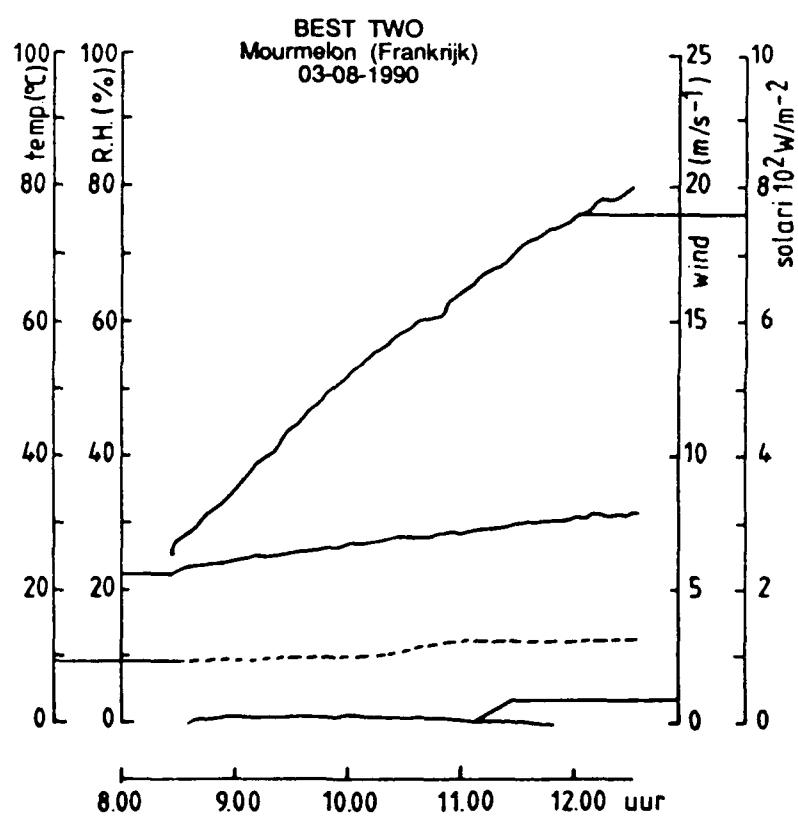


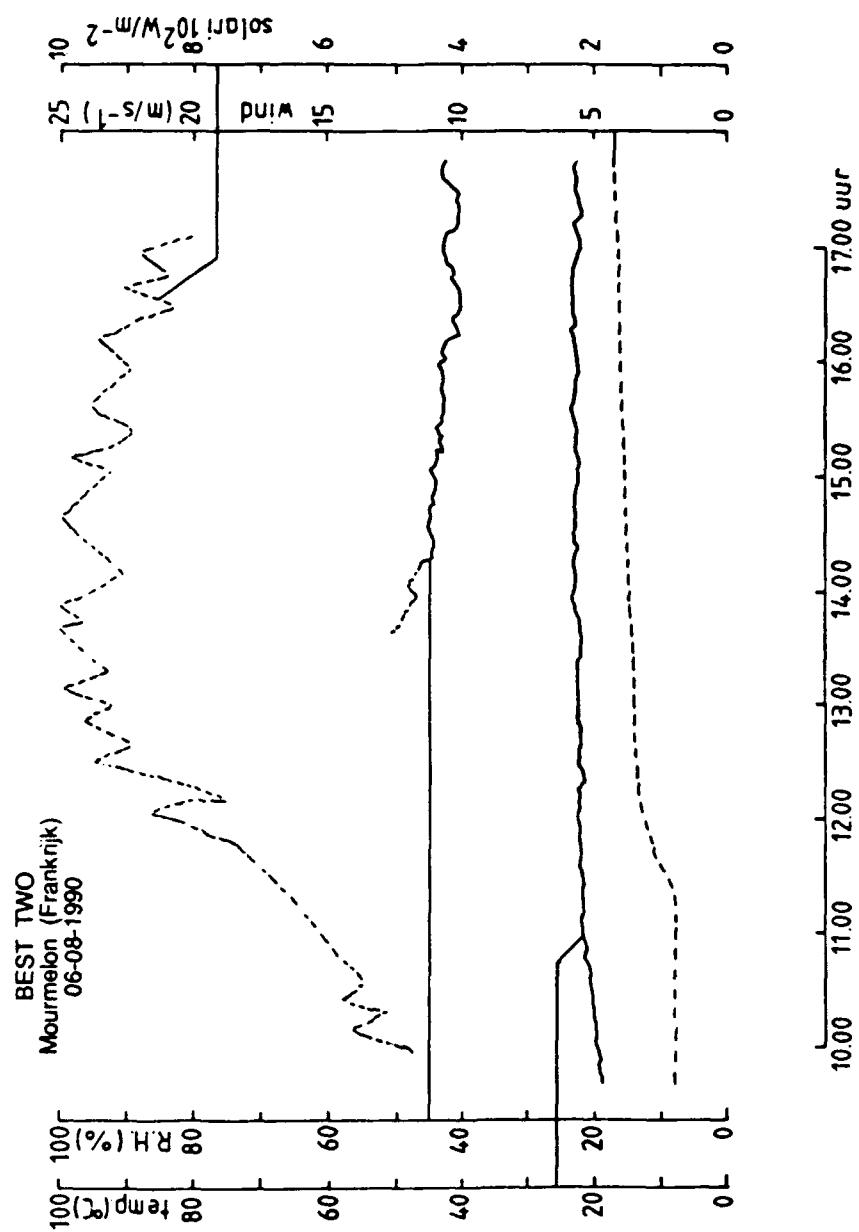


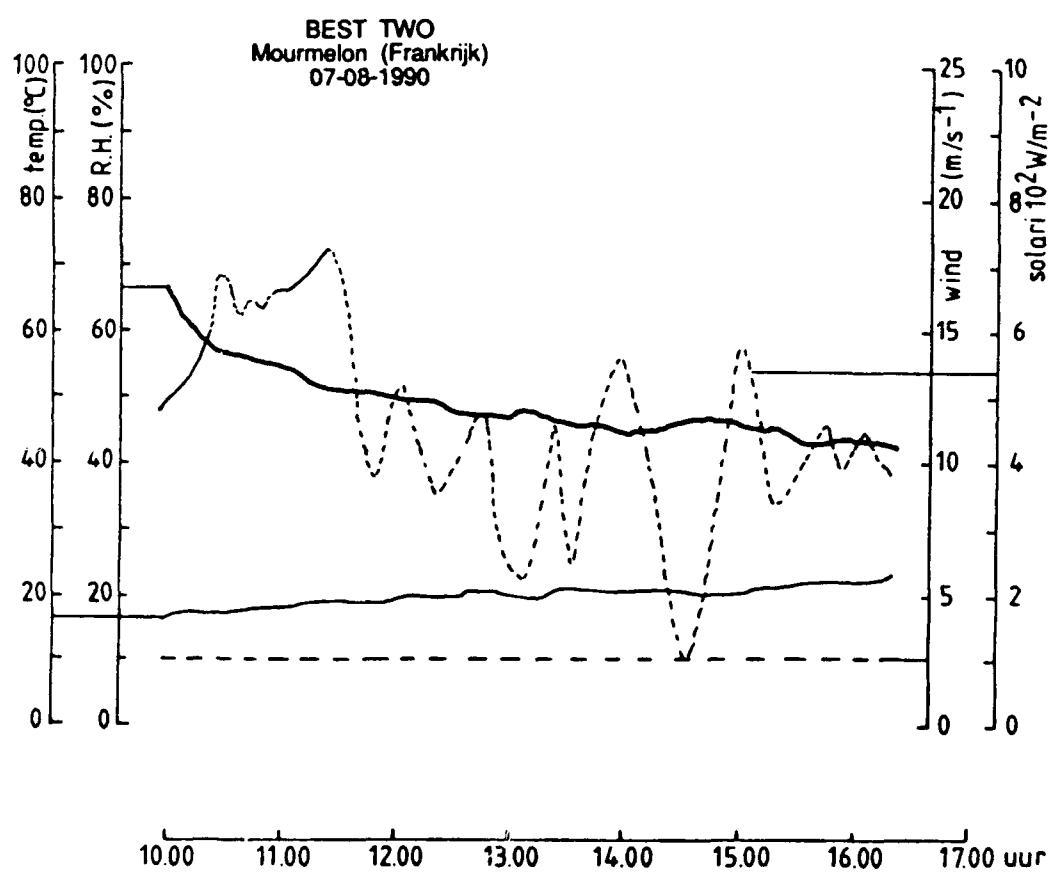


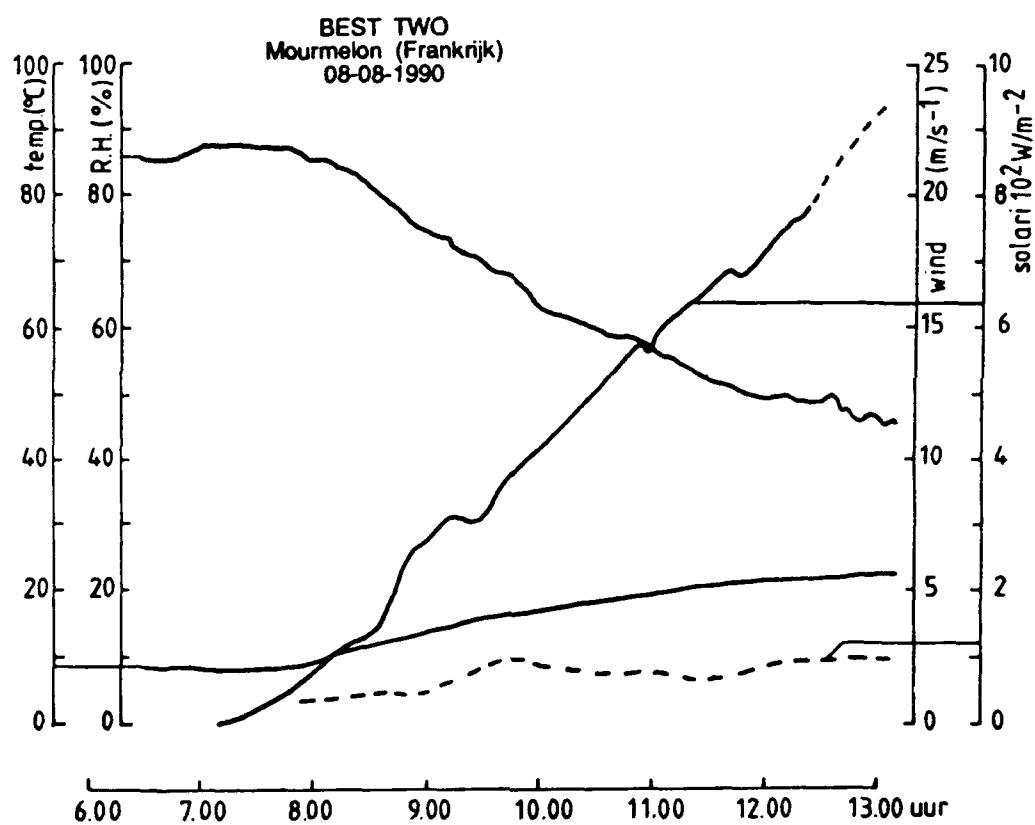


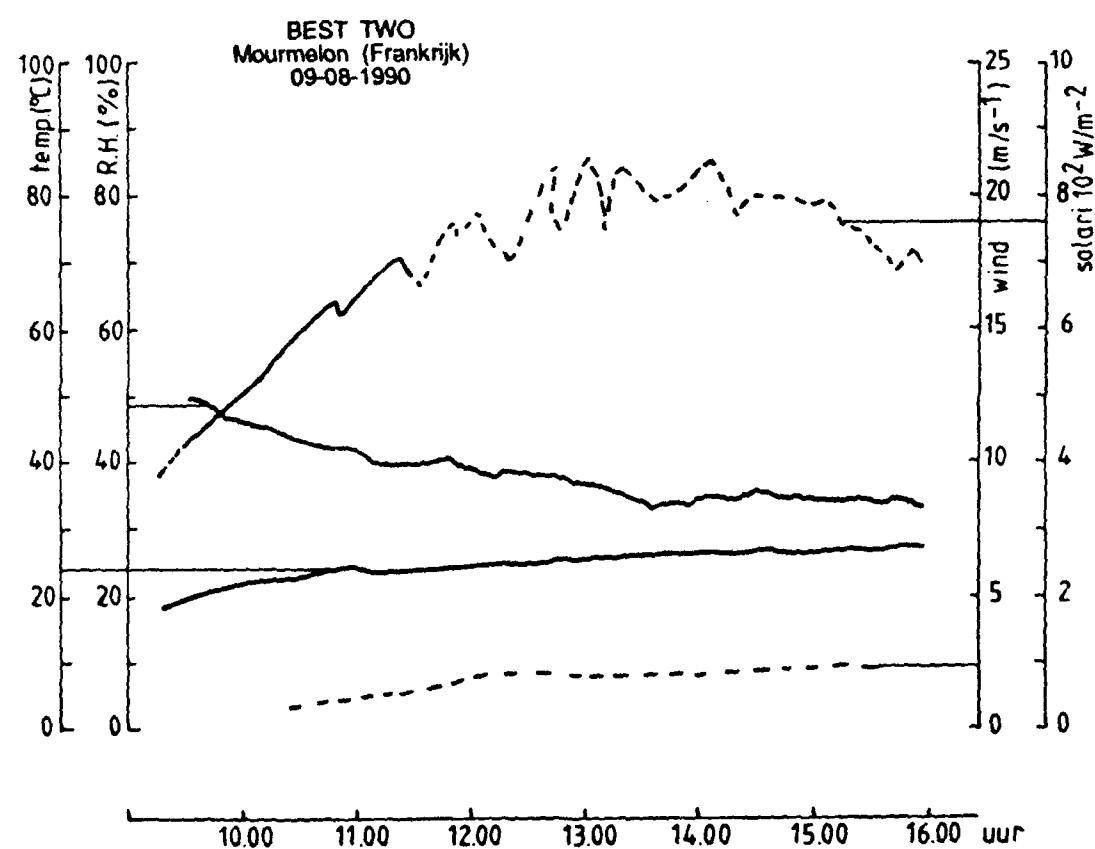












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